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CHARLES W. PRICE
PRESIDENT AND TREASURER
STEPHEN H. GODDARD
SECRETARY
CHARLES T. CHILD
TECHNICAL EDITOR
RUSSELL HOWLAND
GENERAL REPRESENTATIVE

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TO ADVERTISERS
CHANGES for advertisements should be in this office by Friday noon for the following week's issue.
NEW ADVERTISEMENTS should be in the office not later than Monday noon to ensure publication in that week's issue.

The arrival of M. Santos-Dumont, the aeronaut, in this country, will probably do a good deal to stimulate interest in ballooning and in the construction of flying machines of various kinds. M. Santos is so far the most successful builder of dirigible balloons and his work has been most interesting, both from the standpoint of the general public and that of the engineer. An essential to the continued success of his work, however, is a light and powerful source of energy. Up to now he has relied upon explosion engines using gasoline. It is believed, however, that the new type of storage battery produced lately by Mr. Edison may be able to give him a power output superior to that obtainable by gasoline engines of the same weight.

SPRING.

Spring is the season of house-cleaning, not only in domestic establishments, but in all manner of electric light and railway installations as well. For the two it has a different meaning, seeing that it inaugurates the heaviest traffic of the year for the majority of electric street railway plants, while it marks for the electric light station the falling off of the load as days lengthen and the hours of needed illumination grow shorter. In both, however, it is a period of extraordinary activity in the overhauling of apparatus and the making of new plans.

Spring is also the season for undertaking outside construction work, which perforce awaits through the winter the thawing of the ground and the disappearance of frost. From present prospects there will be an unusual amount of outside construction undertaken in this country during the coming summer. A considerable number of long-distance transmission lines are about to be installed, while the growth of the ubiquitous trolley road keeps up at a pace which shows no sign of slacking. This summer will also witness a considerable extension of long-distance telephone lines and the application to them of the "loading" system, invented by Dr. Pupin, which will greatly enhance their working qualities.

It should not be forgotten by those in charge of electric lighting installations that the comparatively dull months of the summer are the best time for making extensions and putting in new apparatus to meet the demands of next winter's load. The history of electric lighting of recent years has been marked by consolidations and the suppression of useless plants. The electric lighting of large neighborhoods has been gathered together so that it can be handled conveniently from single central stations. This has been made possible by the increasing perfection of methods of generation, and of appliances for line construction permitting the use of high voltages, both overhead and in underground cables with perfect safety. A large number of cities in the country will this summer enforce ordinances requiring the burial of wires, so that great activity in conduit and cable interests is to be expected.

The entire prospect for the summer's work is pleasing. In no department of electrical activity is there any indication of slackness, and the outlook seems to be for large and profitable activity in all directions.

THE FUTURE OF THE HORSE.

Some interesting statistics lately published by our lively French contemporary, *La Locomotion Automobile,* show that in Europe the horse is rapidly disappearing in the various large cities. For example, in Paris the total number of horses in 1901, according to a municipal census of these animals, was 96,698, while this year it is only 90,796, a falling off of about six per cent. In London, in the same period, the equine population has decreased ten per cent, while in Berlin, Vienna, and even in St. Petersburg the same falling off exhibits itself. This is partly due to the new trolley roads, and very largely to the numerous and continual increase in the number of automobiles used both for pleasure and business.

In this country the supersession of the horse by the trolley car has been absolutely astonishing in its extent. Probably to-day in New York there are not more than two-thirds as many horses employed as were used twenty years ago. So far, the automobile appears to have made no great inroads into the horse business, and it is likely that the extension of the use of automobiles will have to wait upon the growth of more scientific ideas regarding street-paving and road-making. However, the decadence of the horse is upon us and his disappearance may be looked for sooner or later.

As certainly as anything can be predicted the progress of engineering ad-

vance will totally extinguish the horse as a beast of burden. We may look forward with certainty and satisfaction to the day when cities at least will be horseless and when we will be removed from the tyranny of this animal, which has imposed upon us stone-paved streets, unending dirt and, curiously enough, the house fly—an insect dependent upon the existence of stables for its birth and breeding. What the future of the horse will be is hard to say. It is likely that horses will continue for centuries to come to be used as instruments of sport and pleasure, but the day of their emancipation from hard labor in the streets and roads is not far distant.

THE LEGAL ASPECT OF WIRELESS TELEGRAPHY.

Certain commercial and engineering circles in Europe are at present much exercised by the dispute between Mr. Marconi on the one hand, and Herren Slaby and Arco, the German Government and Herr Braun on the other. There is much threatening of suits, counter-suits, injunctions and other dreadful weapons of the law, and the German Government has refused to allow its territory to be used as a theatre of Marconi operations. Endless litigation is apparently in sight and the chances are that this will be by no means entirely in the interest of the advance of the art.

It would be most interesting to go back to the very beginning of the study of electrical phenomena and find out when the various actions upon which wireless telegraphy is dependent were first noticed. It was in the year 1837, or thereabouts, that Professor Joseph Henry used the spark-gap for the production of electric waves and noted them at a distance, this being probably the first example of wireless telegraphy, and very considerably antedating the efforts of later experimenters. The coherer has been known a number of years, and upon its use apparently depend all of the working systems of wireless telegraphy in vogue to-day. From these and other similar considerations it does not seem likely that any basic patent upon the art of wireless telegraphy can be maintained. A demonstration to this effect by an unsuccessful lawsuit might open the entire art, and thereby greatly benefit it.

Meanwhile, in all the discussion, the fact that Mr. Marconi has accomplished real and genuine results and that his system is operative and has been found useful should not be forgotten. It is one matter to invent a thing and quite another to reduce it to practice and make it work. The work of Hertz and some of the earlier work of Professor Lodge, undoubtedly laid the foundation for successful wireless telegraphy; but these gentlemen did not send wireless messages. The brilliant mathematical analysis of Mr. Heaviside contains the essence of the art of loading telephone circuits, but it is not recorded that Mr. Heaviside ever improved a working telephone circuit by the use of the apparatus he foresaw. So it is with wireless telegraphy. To us it seems that the credit belongs very largely to the man who took what had been done as the basis for erecting a structure of practical value and definite success.

THE INTERSTATE INDEPENDENT TELEPHONE ASSOCIATION.

The Interstate Independent Telephone Association, which comprises the operating independent telephone companies of the middle states, has been successfully launched upon its career of usefulness after a somewhat strenuous session of the first convention of the association at Chicago. The objects of this organization are to promote the general welfare of independent telephone companies in that section of the country, where they have their largest extension, and in various ways to exploit independent telephony for the benefit of those concerned in it and of the public. Notwithstanding the difficulties attending the formation of the organization, it has satisfactorily passed through the difficult preliminary stages and is now a full-fledged society which will doubtless be able to accomplish results of great importance and value for the industry which it represents. The work of all such associations is immensely useful. If they accomplish no more, they bring their members together periodically so that they become acquainted, and in this way they foster a better understanding and the undertaking of new projects requiring cooperation of one sort or another. The new society will start its career with the best wishes of all those who believe in the future and the importance of independent telephony.

LORD KELVIN.

On the evening of April 21 the American Institute of Electrical Engineers will tender a reception to Lord Kelvin and Lady Kelvin at Columbia University. The National Academy of Sciences, the American Association for the Advancement of Science, the American Mathematical Society, the American Physical Society, the Astro-Physical Society of America, and the New York Academy of Science will join officially with the Institute in tendering this reception.

Nothing is more fitting than that American electrical engineers and physicists should unite in extending these courtesies to the man who may be properly regarded as the dean of electrical engineers. The achievements of Lord Kelvin, begun during his modest career as Professor William Thomson, of the University of Glasgow, have added imperishable lustre to the records of nineteenth century engineering. Selected as one of the foremost mathematicians and electricians of that day he successfully carried out the gigantic project of laying the submarine Atlantic cable between the continents of Europe and America, and saw his predictions fulfilled with great accuracy in the practical outcome of his work. His labors as a scientist and electrician have laid the foundation for many of the most important advances that have been made, both in pure science and in engineering. His keenly analytical mind has grasped and solved many of the recondite problems which have been presented by the advance of discovery and the increasing interest of the race in its condition and surroundings. Outside of his purely electrical labors he will be remembered for his magnificent work in pure physics, especially in connection with the phenomena of tides and his expositions of the physical actions involved in the movement of molecules and the ether. It will be a great pleasure again to welcome him on this side of the Atlantic, and for the various societies enumerated above to tender this modest worker, who has so well earned the titles of distinction he wears, their congratulations upon a career so filled with usefulness.

RAILWAY SIGNALS.

The speed of railways is limited by several considerations beyond those of effectively applying motive power to the moving train. The two most important considerations which limit speed are the questions of signals and of brakes. Obviously brakes are as essential and important as motive-power apparatus, because the train must be stopped with reasonable celerity, while the whole conduct of a railway depends upon the maintenance of efficient and safe signal devices.

In the methods of railway signaling now in general vogue may be traced another of the engineering survivals which have descended to us as a legacy of the postroad and the stage coach. With the lower speed of such vehicles, which could be stopped anywhere in their course and directed by word of mouth, fixed signals, placards, sign-posts and such things were quite sufficient to direct the stage along its course without difficulty and without unreasonable loss of time. With the coming of steam locomotives and higher speeds, practically all that has been done is to translate the information given to those having charge of the train into certain simple signals which are displayed either by colored lights or semaphore arms. When further orders—information that can not be given by the semaphore or the colored lamp—are necessary, the train is stopped and written information telegraphed to the stopping place is put aboard of it. For all ordinary running, however, the signals transmitted from the fixed apparatus, which the engine man must see and understand correctly, are limited to information that the track is clear or otherwise, that the train may proceed in safetv or that it must stop, or that it must run slowly and with caution.

All of the existing signals, excepting only the torpedo, which is an emergency appliance, require that the engine driver shall see and interpret correctly the fixed signals standing alongside the track or suspended over it, and this when the speed of approach is often in the neighborhood of a hundred feet per second. Signals must be seen and understood in rain, snow, fog or darkness; a mistake or a second's inattention on the part of the engineer may result in some such disaster as that which lately occurred in New York city.

In the present state of the electrical art the signals could as well be given in the locomotive cab as alongside the track. They could be displayed immediately before the eye of the engine man and made so prominent, so conspicuous and of so many kinds that it would be utterly impossible for him to fail to see them. They might even be interlocked with the control gearing of the train so that if, upon the exhibition of a danger signal, the train was not immediately stopped the signal itself might cut off steam and set the brakes. The subject of railway signaling, therefore, seems to open up an important new field of immense extent, which has been by no means exploited. It is evident that the limit of satisfactory signaling to moving trains has been approached, if not reached, and that further increases of speed to be accompanied by perfect safety of operation will involve another method of communicating orders and information to the moving train.

No system of signals, as such, can dispense with the human element involved in the engine man's understanding and interpretation of the signals displayed. It seems likely that the signaling apparatus of the future will be at least in some degree interlocked with the mechanism of the locomotive, whether this be steam or electrical, so that the emergency danger signals, at any rate, will automatically cause the stoppage of the train even if overlooked by the driver. The subject is one that seems to invite the attention of inventors as well as the careful and earnest study of those having charge of railroads.

FAN MOTORS.

At this season of the year the importance of the fan motor as a daylight load for electric light stations should not be overlooked. The public of this country has turned what was formerly a luxury into a necessity in the case of the fan motor, and the increase in the use of these appliances has been extraordinary. They give to the electric light station supplying current for them a variety of load that is of the most desirable kind. The majority of such motors in places of business operate long hours through the daytime in summer, this load going off generally before the evening period of illumination sets in. The consumption of current by fan motors is small, but the hours of operation are generally long and the total income that may be derived from them is often surprisingly large, especially in the larger cities, where buildings are close together and often illy ventilated, naturally. The manufacture of these little machines has reached a point such that they are very fully standardized and are extremely satisfactory both to the purchaser and to those who supply power for their operation. Their price has been reduced by competition among the makers to an exceedingly reasonable point, and the fashion for their introduction is becoming fixed. The question of their purchase by electric light stations and rental to customers, is one that deserves and will bear careful investigation.

A NEW FIELD FOR TELEGRAPH OPERATORS.

Word comes from the West that the pay stations and central offices of a large telephone system are to be equipped with telegraphic apparatus, using the same wires, and that the telephone company is to conduct a telegraph business over its own circuits. Methods of operating telegraph apparatus on telephone lines have been known for a number of years, and some of the long-distance telephone circuits between New York and western cities are to-day used simultaneously for telegraphic purposes. The convenience of combining telegraphic and telephonic transmission from the same offices is immediately apparent and will doubtless be of considerable advantage to the business community; but the interesting feature of the situation is that it may portend larger consolidations hinted at in these columns recently. Naturally, it also means that telephone operators in those regions must learn telegraphy.

It stands to reason that sooner or later the methods of transmitting intelligence by electricity should be consolidated. The experience of many communities with two telephone systems is paralleled by the experience of the whole country with competing telephone and telegraph systems, often two or more of each. It does not require prophecy to foresee what the outcome of this peculiar situation must be.

RADIO-ACTIVITY AND THE ELECTRON THEORY.*

BY SIR WILLIAM CROOKES.

Electrons emanating from radio-active bodies behave like material particles, and are impeded by the molecules of the surrounding medium in contrast with ether waves, which are not thus affected except by absorption. It is not difficult to put these indications to test. A pair of shallow cells, AB (Fig. 1), 1.5 mm. deep and 25 mm. square, were made by cementing slips of glass to a thick glass plate. The cells were filled to the same depth with a radio-active substance chiefly containing actinium.† Over cell A was placed a piece of thick lead pipe, 28 mm. high and 25 mm. internal diameter, to ensure that any emanations from the active substance in A would be confined to the inside of the hollow cylinder. The radio-active substance B was freely exposed to the air, save for a pillar of lead at C to support the sensitive film. A sensitive film was laid horizontally over the cylinder and support C. On the film was a plate of glass, and cylinder and film were pressed together by heavy weights. The whole was covered in a light-tight box and put in a dark cupboard. At the end of forty-eight hours the film was removed and developed. There was a strong action shown over cell A (the one covered by the lead cylinder), but over B, the cell exposed to the air, there was no visible impression. Measured in Mr. Chapman Jones's "opacity meter"‡ the results were:

Image over cylinder—Opacity log § = 0.79;
Opacity ‖ = 6.17.

The experiment was repeated, using the same apparatus but a different preparation of actinium. In this case the exposure was for seventy-two hours. As before, there was a strong impression over cell A and none over cell B. The figures were:

Opacity log = 0.89; Opacity = 7.71.

These experiments indicate that the electrons from the radio-active agent, chiefly actinium, partake of the properties of a fog or mist of material particles, capable of diffusing away in the free air like odoriferous particles, when not kept in by a thick metal screen.

A further experiment was now tried with the same apparatus, the agent a strongly active radium and barium bromide. This material being self-luminous, a sheet of black paper was placed immediately over it so that nothing but emanations capable of passing through the opaque paper would be subject to experiment. After four hours' exposure in total darkness the film was developed. A good circular patch was obtained over cell A, and a faint diffused darkening showed over the rest of the film, darker at the spot immediately over cell B, fading away at the sides as the distance became greater. That this action was due to the material in the open cell B, and not to general fog over the plate, was seen by the clearness of the film where covered by the lead and where shadows were thrown by the lead cylinder and pillar. Circles of the same diameter were drawn round the dark impression over A and around the darkest

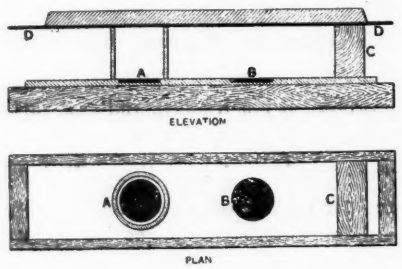


FIG. 1.

part of the impression over cell B. Measurements were taken of different parts of the spaces enclosed in these circles, and the mean of all these came out:

Circle over cell A—Opacity log = 0.53;
Opacity = 3.39.
Circle over cell B—Opacity log = 0.32;
Opacity = 2.09.
Ratio B/A = 0.62.

The experiment was repeated with the addition of a sheet of aluminum, 0.02 mm. thick, under the black paper, the electrons now having to pass through both paper and metal before reaching the film. The exposure was for six hours, and the appearance on development was very similar to the last; a dark disc over the protected cell A, and a diffused action over the other part of the film, except in the shadow of the lead supports. Measurements as on the previous occasion gave the following results:

Circle over cell A—Opacity log = 0.78;
Opacity = 6.03.
Circle over cell B—Opacity log = 0.48;
Opacity = 3.02.
Ratio B/A = 0.5.

A third experiment was tried with the same apparatus, using only the aluminum plate as a screen to cut off the luminous rays. The appearance on development was similar to the others, and the measurements of opacities were:

Circle over cell A—Opacity log = 0.59;
Opacity = 3.89.
Circle over cell B—Opacity log = 0.29;
Opacity = 1.95.
Ratio B/A = 0.5.

Finally I tried polonium subnitrate, which gives off emanations hardly capable of passing through any screen, and greatly obstructed by a few centimetres of air. The apparatus was substantially the same as the one just described, with the modification that the lead cylinder was 12mm. high, and at the other end a rod of glass 12 mm. high was used to support the film. The reduced height was chosen, experience showing that the polonium emanations have great difficulty in penetrating many millimetres through air. The exposure was seven days, at the end of which time the film was developed. Over cell A a dark disc sharply defined the inside of the cylinder, while over cell B was a hazy diffused patch, which, to the eye, looked much the fainter of the two. But measurements of patch A and of a disc over cell B of the same size as A showed that the opacities in each case were practically identical, as shown by the following figures:

Circle over cell A—Opacity log = 0.74;
Opacity = 5.49.
Circle over cell B—Opacity log = 0.76;
Opacity = 5.75.
Ratio B/A = 1.05.

A repetition of the experiment, taking the mean of five concordant results, gave the same opacities as before. Without proving that the emanations from polonium are less material that those from actinium and radium, this experiment shows that their behavior is entirely different as regards diffusibility through air. Whether this is due to the larger mass of the individual particles, or to the less distance they have to travel (12 mm. as against 28 mm. in the case of actinium and radium), or to some other cause, further experiments must decide.

M. and Madame Curie have shown that radio-activity is communicable from radium and actinium compounds to bodies such as lead, copper, glass, ebonite and paraffin. After exposure to emanations from the radium compound these bodies have the property of communicating temporary conductivity to the air and other gases, and of thereby discharging an electrified body. When such charged bodies are exposed to the air, in a single day they lose the greater part of their activity. These phenomena are observed with dif-

* Paper read before the Royal Society, London, February 6, 1902.

† The body I called uranium X in my Royal Society paper, May 10, 1900, has since proved to be M. Debierne's actinium.

‡ The *Photographic Journal*, vol. XX, p. 86, December 21, 1895.

§ The opacity logarithm represents the density of the image, absolute density being represented by 2.00.

‖ The "opacity" is the whole number corresponding to the "opacity log." The "opacity" is directly proportional to the photographic energy acting on the sensitive surface.

ferent radio-active salts of radium, also with salts containing actinium; but polonium compounds, even when very active, do not communicate the effect. Dr. Rutherford shows that air which has remained for some time in the neighborhood of thoria, and then is carried in a current to a distance, retains its property of communicating radio-activity to other bodies. He explains these phenomena by supposing that thoria gives off a special kind of emanation capable of being conveyed by the air, and that this is the cause of the induced radio-activity.

To ascertain if the electrons or corpuscles from radium also possess the property of being carried along in a current of air I fitted up an apparatus shown in Fig. 2. A, B and C are three brass tubes closed at the lower end and cemented with paraffin to a wooden block. The upper ends were accurately ground to a level surface, and then coated with a thin layer of paraffin wax. Holes were drilled in B and C, to admit glass tubes, cemented air-tight into the cylinders, as shown in the figure. The upper end of the tube in B was closed with a plug of cotton wool, and the outer end in C was connected to a water pump, so that when the cylinders were closed at the top a current of air was drawn through B and C. As the radium compound was self-luminous, discs of thin aluminum foil were placed over cylinders A and B to cut off the luminous rays. A sensitive film was laid on the three cylinders over the aluminum, and it was tightly pressed down by a heavy weight, the contact between the film and the tops of the cylinders being sufficient to make the whole air-tight. At the bottom of A and B a radium compound was placed, equal weights and equal surface in each. The whole was put into a light-tight box and air drawn through. The cylinder A was used only as a standard. The air passing through B was expected to carry along with it some of the corpuscles emitted from the active material at the bottom, and the inlet tube in C was turned up at the end so that the stream of corpuscle-laden air should impinge on the surface of the centre of the film on C, and if it carried with it any radio-active properties the result should be seen on development by the production of a dark patch. If, however, the air carried no corpuscles there would be no image on the sensitive film over C. The experiment was continued for eleven hours, 120 litres of air having passed through in the time. On development and measuring the resulting images the following figures were obtained:

Circle over cell A—Opacity log = 0.342;
Opacity = 2.20.
Circle over cell B—Opacity log = 0.178;
Opacity = 1.51.
Circle over cell C—Opacity log = 0.025;
Opacity = 0.11.
Ratio B/A = 0.68.

The apparatus was slightly altered. Cells B and C were put nearer together, and a short wide brass tube replaced the turned-up glass tube formerly connecting them. The experiment was continued for forty-eight hours, during which time about 500 litres of air passed through the apparatus. This repetition, allowing longer time, gave measurements as follows:

Circle over cell A—Opacity log = 0.964;
Opacity = 9.20.
Circle over cell B—Opacity log = 0.730;
Opacity = 5.37.
Ratio B/A = 0.58.

In this experiment a slight but measurable darkening took place over cell C, shown by an opacity log of 0.025 and an opacity of 0.11. This shows that some few

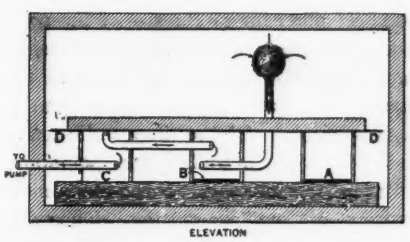


FIG. 2.

corpuscles have been able to pass through the wide tube from B to C and act on the photographic film.

It thus appears that a current of air passed over the surface of a radium compound carries with it a certain proportion of the corpuscles. This is proved by the diminished photographic action in the second cell, slightly confirmed by the evidence that some few of the corpuscles so carried away get to the sensitive film on cell C. Judging from our slender knowledge of the properties of free electrons it is highly probable that they will not easily turn a corner, but cling to the sides of the tube through which they are being led. On the other hand, the constant collisions with the atoms of air may reduce their initial mobility almost to a vanishing point before they have traveled along the tube between B and C, and then they would be carried along with the air. The experiment was repeated, using a preparation of actinium (uranium X). It was kept going for seventy-two hours, during which time 750 litres of air were drawn through the apparatus. On development and measurement the following results were obtained:

Circle over cell A—Opacity log = 0.99;
Opacity = 9.78.
Circle over cell B—Opacity log = 2.67;
Opacity = 4.68.
Circle over cell C—Opacity log = 0.25;
Opacity = 1.78.

Thoria prepared by the ignition of Dr. Knöfler's highly purified thorium nitrate* was now tested in a similar apparatus to the one last described, the only alteration being the removal of the covering aluminum plates, thoria not being self-luminous. The experiment was continued for 108 hours, 1,125 litres of air being drawn through the cells during the time. Measurements of the developed images gave the following results:

Circle over cell A—Opacity log = 0.306;
Opacity = 2.02.
Circle over cell B—Opacity log = 0.260;
Opacity = 1.82.
Circle over cell C—Opacity log = 0.046;
Opacity = 0.10.

Here also the results agree with those tried with radium and actinium compounds, that corpuscles are carried by a current of air from cell B through the connecting tube to cell C. They also confirm those of Dr. Rutherford—who finds that thorium emanations travel in a current of air while retaining their activity—and of P. Curie and A. Debierne, who show that induced radio-activity can be transmitted through capillary tubes of an internal diameter of 0.1 mm. and 75 cm. in length, bent once at right angles. I have not obtained, however, a similar result with the emanations from hydrogen peroxide. As shown by Dr. Russell, this substance has a strong action on a sensitive photographic plate. The emanation from a bottle half full of hydrogen peroxide acts strongly on a sensitive film laid over the open mouth of the bottle for twenty-four hours, while there is no action in seventy-two hours if a U-shaped tube passed through the cork of the bottle and the sensitive film is put close to the open end of the tube. Dr. Russell tells me his observations confirm my experiments.

A highly active self-luminous radium compound loses some of its power on long exposure to the ordinary air of the laboratory. Ignition to red heat restores, however, its self-luminosity, and when sealed in a vacuum its activity remains as great as at first. When enclosed in glass the glass soon assumes a pink color, which is not superficial, as already observed by M. and Madame Curie. By immersing a section of the glass in a liquid of the same refracting power as itself the color is seen to penetrate below the surface. If, however, the radium compound is sealed

* Proc. Roy. Soc., vol. lxvi, p. 421, May, 1900.

in vacuo in a *quartz* tube no coloration takes place, and I can detect no diminution of energy even in twelve months.

Electrons from radium will pass through aluminum and a considerable length of air and effect a sensitive film.* Experiments on this point were tried with polonium, and it was found that air offered great obstruction. Three shallow cells 17 mm. in diameter and 2 mm. deep were filled with polonium subnitrate, the same quantity in each cell, the surfaces being leveled. Over these cells were fixed three pieces of lead pipe of lengths of one inch, two inches and four inches, so that each cell of polonium had its emanations confined to its own tube. Sensitive films were put over each tube, and the whole kept in total darkness for 144 hours. At the end of that stretch of time the films were developed. No image was seen on the film four inches from the polonium; a faint image was perceptible on the film two inches off, and a stronger one on the film one inch off. Measured in the opacity meter the figures were:

Over 1-inch tube—Opacity log = 0.18;
Opacity = 1.51.
Over 2-inch tube—Opacity log = 0.04;
Opacity = 0.11.

A repetition of this experiment, using tubes of glass instead of lead, gave almost identical results.

The electron theory explains a fact which has long puzzled experimentalists. It is well known that if a coin is laid on a sensitive plate in perfect darkness and connected with one pole of an induction coil for a few seconds and then developed an image can be obtained of the raised parts of the coin. This has generally been explained by saying that the electrical stream of air, or the "brush discharge," affects the film like light. But Mr. F. Sanford† shows that coins embedded in the centre of a block of paraffin 2 cm. thick, where they could not send off streams of electrified air, can still be photographed by means of the induction coil. Under these circumstances it is probable that electrons are the agents, as electrons will easily pass through paraffin wax from the coin to the sensitive plate when the coin is connected with the negative pole of an induction coil, the other pole being connected with a metal plate placed below the wax block.

Hitherto we have been dealing with negative electrons—a free positive electron at present is unknown. In a paper communicated to the Royal Society, December, 1900,* the Hon. R. J. Strutt offers a suggestion as to positive ions which in a satisfactory manner appears to explain much that hitherto has been left doubtful, not to say contradictory. He adopts the generally recognized theory that the deflectable Becquerel rays consist of a stream of negative corpuscles with enormous velocities proceeding from the radio-active body. But there are two kinds of Becquerel rays, one deflectable and penetrating, the other non-deflectable and easily absorbable. Mr. Strutt considers that these non-deflectable rays are positive ions moving in a stream from the radio-active body. He says: "We know that the positive ions in gases carry the same charge as the negative, and that they have an enormously greater mass. Unless, therefore, their velocity is smaller out of all proportion than the negative ions, it is to be expected that they will be much less easily deflected by the magnet. . . . Next it may be noticed that the smaller penetrating power would be well accounted for by the size of the positive ions, which would, of course, make more collisions with the molecules of the surrounding gas than the much smaller negative ions." Of the three radio-active bodies, radium, actinium and polonium, actinium appears to emit corpuscles almost entirely of the penetrating, deflectable kind, polonium rays of the non-deflectable, non-penetrating kind, while radium emits rays of both kinds. On the above hypothesis corpuscles from polonium might consist of the heavy positive ions; to test the accuracy of this inference experiments are now in progress.

Some curious and far-reaching inferences may be drawn from Mr. Strutt's view, supposing it to be correct, that positive as well as negative corpuscles will fly off from a radio-active body. In a paper "On Electrical Evaporation"† I showed that many bodies such as silver, gold, platinum, etc., usually considered non-volatile at ordinary temperatures, easily volatilize in a vacuum if connected with the negative pole of an induction coil, remaining fixed when connected with the positive pole. This phenomenon was first observed by Dr. Wright, of Yale College, and was applied by him for the production of mirrors for physical apparatus. It is shown by experiments that the action in the vacuum tube is of two kinds. A silver pole was used, and near it, in front, was a sheet of mica with a hole in its centre. The vacuum was very high (P = 0.00068 mm.), and when the poles were connected with the coil, the silver being negative, electrons shot from it in all directions, and passing through the hole in the mica screen formed a bright phosphorescent patch on the opposite side of the bulb. The action of the coil was continued for some hours to volatilize a certain portion of the silver. On subsequent examination it was found that silver had been deposited only on the mica screen and in the immediate neighborhood of the pole, the far end of the bulb, at the spot which had been glowing for hours from the impact of the electrons, being free from silver deposits. Here then are two simultaneous actions. Electrons, or as I once called them, "radiant matter," shot from the negative pole and caused the glass against which they struck to glow with phosphorescent light. Simultaneously the heavy positive ions of silver, freed from their negative electrons, or under the influence of the electrical stress, likewise flew off, and were deposited in the metallic state near the pole. An experiment was tried to discover if the ions of metal, deposited in this manner on a metal plate connected with an idle pole in the full stream of + ions and — electrons, showed any special + or — electrification. In all cases the electrification was positive. This lends support to Mr. Strutt's view that + ions as well as — electrons will fly off from a radio-active body. Even these results, however, must not be taken as conclusive, for in a paper published in 1891,* I showed that at a high vacuum nearly the whole of the interior of a tube through which an induction spark was passing was electrified positively, negative electrification being detected only in the immediate neighborhood of the negative pole.

During the course of my experiments a curious circumstance was observed, which deserves record, as it may elucidate some of these obscure phenomena. While the volatilization of the silver pole is rapidly proceeding the metal glows as if red hot. This "red heat" is superficial only. The metal instantly assumes or loses the appearance of red heat the moment the current is turned on or off, showing that the high temperature does not penetrate below the surface. The volatilization of the positive ions is confined to the surface, and the surface glow is connected with that action. If instead of silver, a good conductor of heat, I take diamond, a bad conductor, the surface layers are changed sufficiently to convert them into a form of graphite, which from its great resistance to oxidizing agents, can not be formed at a lower temperature than 3,600 degrees centigrade.

* Using an active compound of radium, I have obtained an impression on a sensitive film through a penny piece.

† *Nature*, vol. lv, p. 485.

* *Phil. Trans.*, A, 1901, vol. ccevi, p. 525.

† *Proc.* Roy. Soc., vol. l, p. 88, June, 1891.

* "Electricity in Transitu; from Plenum to Vacuum," *Journal* Institution of Electrical Engineers, vol. xx, p. 10.

ELECTRIC SHOCKS.

THREE PAPERS AND DISCUSSION AT THE BRITISH INSTITUTION OF ELECTRICAL ENGINEERS.

[*From our Special Correspondent.*]

The most interesting discussion at the Institution of Electrical Engineers so far this session has been that which followed the reading of papers on the subject of electric shocks by Trotter, Aspinall and Webber. Each of these gentlemen treated the subject from different standpoints, but from a public point of view the most effective was that of Mr. A. P. Trotter, the electrical adviser to the Board of Trade, who followed up the reading of his paper by a number of personal experiments.

Mr. Trotter, in his paper, recorded a few experiments and discussed the conditions under which shocks at 500 volts are devoid of danger, in view of the misapprehension at present existing as to the circumstances under which shocks at this pressure are likely to lead to serious consequences. Modern journalistic sensationalism, he said, had made the most of the trolley-wire accidents in Liverpool early last year, and irresponsible correspondents had suggested in the newspapers that to fall on the centre working rail of the Central London Railway was to be grilled alive. He divided his subject as follows: (1) The physiological and electrical conditions; (2) the dangers connected with trolley wires; (3) the dangers of third rails of electric railways.

On the first division of his subject he maintained that fatal accidents from 500 volts were so rare that the conditions could only be guessed at. If the skin resistance be reduced by moisture, especially if salt or chemicals be present, and if the contact be large and prolonged, 100 volts might be fatal. In his experiments he had found that the resistance from boot to boot, the soles being dry and without nails, varied from 45,000 to over 200,000 ohms, whereas with boots wetted and worn into holes, a resistance of only 13,000 ohms was obtained. Coming to the dangers connected with trolley wires he maintained that neither the man in the street nor a man on a car runs any risk of taking 500 volts skin to metal. On several occasions he had grasped a trolley wire with both hands while standing on a tramcar and not the slightest sensation was noticeable.

It was the third portion of the paper, however, which caused the most interest and amusement. After detailing how utterly impossible it is to receive a shock from a third rail charged at 500 volts, Mr. Trotter proceeded to demonstrate the fact. On the floor of the meeting house he had erected a six-foot length of track equipped with a centre rail and charging this he sat on it, stroked it with both hands and rolled over and over on it. The spectacle of the usually sedate Mr. Trotter performing these gymnastics was too much for the gravity of the members and roars of laughter and loud applause greeted the efforts of the electrical inspector to the Board of Trade.

Mr. Aspinall, whose paper was also received with great favor, put the following questions to the members for discussion, and although he dealt with each one briefly, the chief object was to invite discussion: (1) Is every one equally susceptible to electric shock? (2) Is a person suffering from disease more likely to be fatally injured by an electric shock than a person in good health? (3) Does the physiological condition one is in at the time a shock is received make any difference? (4) Does the path which the current takes through the body have any effect as regards the shock proving fatal? (5) Does the question of contact made, and whether burning takes place or not, have any effect upon a person's chance of being killed? (6) Can a person receive a fatal shock without a cry, and also can he speak after receiving a fatal shock? (7) Is an alternating or a direct-current shock likely to prove fatal? (8) Can not the doctors give us a more certain method of ascertaining whether a man is dead or not? (9) Can not something more be done to help those who receive a shock? Mr. Aspinall gave many amusing examples, among which were the proof that imbeciles are able to stand higher shocks than ordinary mortals, and that a drunken man is in a similar condition.

Major-General Webber's paper was chiefly composed of a history of the legislature which has led up to electrical generating stations being classed as dangerous trades and now liable to inspection under the Factory Acts. The only other point of interest was his disagreement with the medical profession in regarding the heart as a pump.

The discussion which was carried over two evenings was extremely valuable, but the whole of the speakers were painfully aware that no hard and fast rules can be set down. Fresh conditions seem to arise with every fatal case and misunderstandings still liable to arise. Thus to digress for one moment a fatal case which happened at Sheffield a few weeks ago, and which was certified at the time as electric shock, is now confidently asserted to have been due to concussion of the brain consequent on the man being dragged from a wall socket and falling upon a concrete floor. Only the most important speakers are included below:

Dr. Hedley, of the electrical department of the London Hospital, thought Major Webber was violating one of the first principles of a physiologist's training in refusing to consider the heart a pump. Assuming that the heart was the organ acted upon, the position of the electrodes was a very important matter, and experiments proved that low pressures proved fatal in proportion to the directness of the heart in the path of the current.

Mr. H. D. Fearon, one of His Majesty's inspectors of factory, differed from Major-General Webber and the subcommittee of the Institution in saying that the industry was opposed to the new regulations of the Factory Acts. In fact all his experience went to prove the contrary. At present a large amount of electrical machinery was being manufactured which was splendid, from an electrical point of view, but extremely bad from the safety point of view, and quoting the words of a certain consulting engineer, "It is all a question of capital." Companies and electricity committees would not use the necessary precautions on account of the expense entailed.

Mr. S. Joyce was of the opinion that a low-pressure circuit, of say 200 volts, could be just as dangerous as a high pressure one at over 2,000 volts. It was not so much a question of voltage as the amount of energy expended in the body irrespective of the pressure.

Dr. Legge agreed with the previous speaker. He also expressed great faith in Sylvestre's method of artificial respiration rather than methods of rhythmical action on the tongue. This latter method depended upon the respiratory centre being intact, which was open to great doubt in some cases, whereas Sylvestre's method was quite independent of this state of things.

Mr. H. M. Sayers considered that factory inspectors were utterly incapable of controlling the new interests they were called upon to study under the new Factory Acts, and ridiculed the idea of placing electrical generating stations under these acts.

Dr. Lewis Jones, of St. Bartholomew's Hospital, supported Dr. Hedley in protesting against Major-General Webber's "heresy" *a propos* of the action of the heart. Personally, he did not consider experiments on animals had a true bear-

ing when applied to human beings. He thought every one was liable to shock, but in varying degrees. There were also certain diseases which left the skin in a very favorable condition for a shock. In ordinary life he considered it was the horny skin of the workman's hands which protected him. The effects of electric shock depended upon the area of contact. He disagreed with Mr. Aspinall that a shirt wet with perspiration protected a person, and thought that a person wet with perspiration who escaped with his life after a shock did so not because of such wetness but in spite of it. As to the path of the current in the body this must be through some vital point, and this vital part was usually the heart. Mr. Aspinall's plea for some means of ascertaining if a man was really dead was a very serious thing. Medical men sometimes had difficulty in this matter, but some help could be obtained from an examination of the pupil of the eye. If dead, the cornea was dim and the iris not round. A. W.

London, April 5.

CORRESPONDENCE.

Electric Printing Process.

To the Editor of the Electrical Review:

I am interested in the new process of printing by an electric current passed through the type instead of using ink. I have seen it mentioned, but am seeking complete description of process. Can you put me on track of it? Otis G. Dale.

Oneida, Ill., March 26.

Credits Hertz.

To the Editor of the Electrical Review:

I would suggest the word "Hertzgraphy" for wireless telegraphy, and "Hertzphony" for wireless telephony, because it is by using Hertzian waves that it is possible to transmit intelligence through space, and it would be a monument to the man who first discovered wireless telegraphy.

J. Holmes Wilson.

Carlisle Springs, Pa., March 31.

An "Ethogram."

To the Editor of the Electrical Review:

Noticing your call for suggestions for appropriate words to be used in speaking of wireless telegraphy, I beg to submit the following: "Ethography" for wireless telegraphy, "ethograph" for wireless telegraph, "ethogram" for wireless telegraph message, "ethophone" for wireless telephone.

"Ethography" would, of course, be accented on the second syllable as is telegraphy.

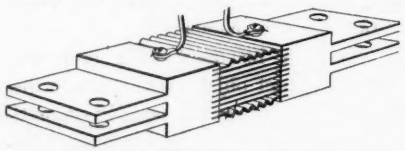
The wireless telephone can hardly be said to be a practical instrument, but it will do no harm to have a word ready for it when it does make its appearance.

Earle L. Ovington.

Boston, April 6.

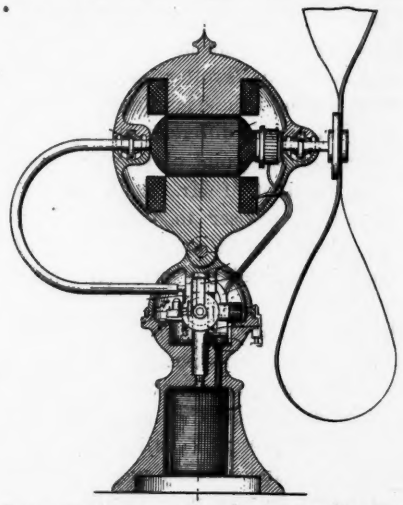
Electrical Patents

The General Electric Company controls a patent on a new shunt for electrical instruments, which was devised by Mr. Morris C. Rypinski, of Schenectady, N. Y. The invention relates to permanent shunts employed especially in measuring instruments, such as ammeters or galvanometers. These shunts as commonly employed have not been interchangeable, but are adjusted for the instrument with which they are used, and as ordinarily constructed they consist of a pair of heavy conducting terminals between which extend a plurality of metal plates separated from one another to admit the circulation of air around them. As is well known, they can not be relied upon for accuracy within less than five per cent, and the common practice has been to adjust them by filing them down so as to give them the exact value required for practical use. This inventor provides a structure which can be readily adjusted by much simpler means, the only distinction from the prior devices residing in making certain of the connecting sheets or strips corrugated to form channels or grooves. By this arrangement, when it is desired to adjust the shunt to the exact degree required for the instrument with which it is associated, the grooves are filled or partially filled with solder until the required resistance is obtained.



Improved Electrical Shunt.

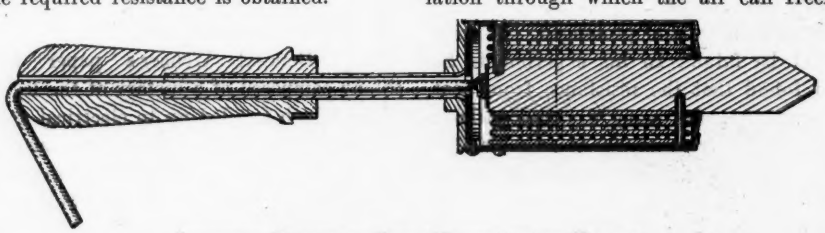
An ingenious electric fan has been invented and patented by Mr. Walter J. H. Jones, of Philadelphia, Pa., whose object is to provide a buzz fan which has a bodily movement on a vertical axis so as to direct a current of air toward every desired part of the room in which the fan is placed. In carrying out his invention he employs a stationary base upon which is rotatably mounted a motor casing, this casing consisting of two hinged sections, the upper of which carries the motor and fan shaft, being so arranged that the fan may be tilted to any angle desired. A circular track is secured to the base and gearing arranged upon the lower section of the movable motor casing engages this track, this gearing being operated by a flexible shaft connected to the motor shaft.



Improved Electric Fan, Rotatably Mounted.

By this arrangement, when the fan is in operation, the motor will be running the gear which engages the track, thereby rotating the entire fan and motor casing on a vertical axis.

The General Electric Company has obtained a patent on a novel soldering iron invented by Messrs. Henry Geisenhoner and Tycho Van Aller, of Schenectady, N. Y. The iron is heated by electricity, and to this end the usual copper point is provided which is surrounded at its rear end by a coil of small wire, the layers being insulated from each other and from the shank by an interposed core of insulating material wound back and forth in zigzag relation between the same. This forms an open network of wire and insulation through which the air can freely circulate, so that when the coil is heated by its resistance to a current of electricity the heat will readily reach the shank of the point. An enclosing insulating jacket surrounds the coil to prevent undue radiation of the heat, and to the rear end of this jacket is secured a hollow shank or stem to which is attached a hollow handle. Through this handle passes the feed wires which are connected to the coil. Iron wire is preferably employed in the coil, each wrap being spaced from those adjacent and bedded in the insulating core so as to be retained in position.



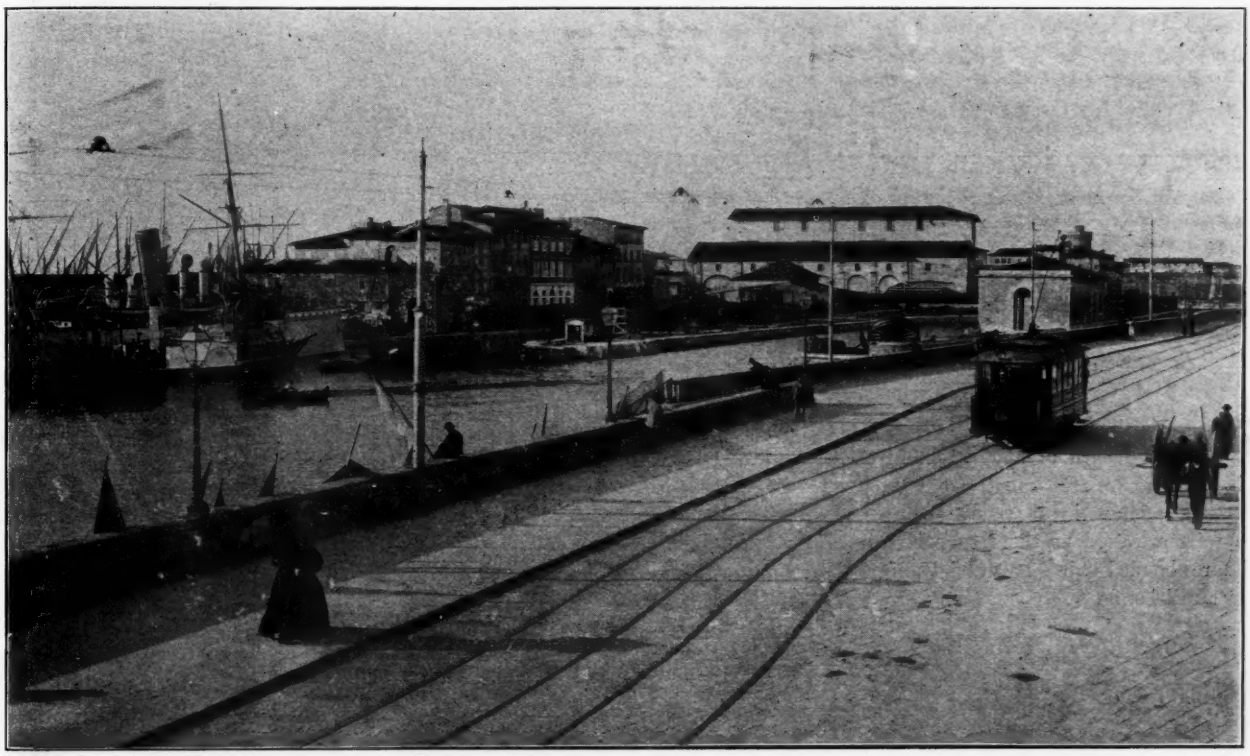
Improved Soldering Iron, Electrically Heated.

The Electric Tramways of Leghorn, Italy.

An Illustrated Description of the City and Suburban Electric Railway Lines of an Italian Seaport.

By Enrico Bignami.

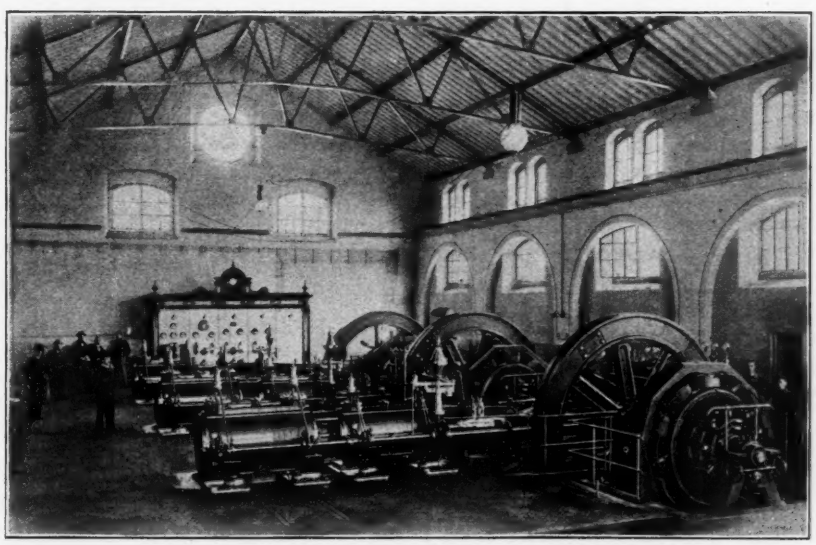
FOLLOWING the example already set by the other principal cities of Italy, Leghorn also has witnessed recently the transformation of its entire system of tramways to electrical operation, and has seen the completion of this system by the construction of interurban lines. At the end of this brief description is given some account of the interurban line to Montenero, which was opened at the end of last year.



THE ELECTRIC TRAMWAY FROM LEGHORN TO MONTENERO, ALONG THE QUAY.

Leghorn, the capital city of the Italian province of Livorno, is one of the most important commercial centres in middle Italy. Its magnificent situation and refreshing sea air attract to it, in the warm months of summer, crowds of strangers, so that the city also has some importance as a watering-place and sanatorium. Considerable dissatisfaction was expressed by many of these summer visitors concerning the insufficient accommodation of the old horse-car lines, doubly bad on account of the poor condition of their equipment. On this account the tramway company decided to install electric traction, and to this end gave a contract for the equipment to the Elektricitäts-Aktiengesellschaft, of Nürnberg, Germany.

The tramway system comprises three lines, with a length of twenty-four kilometres (fifteen miles) of track. The old rails, which were put down for the horse-traction service, were in part kept in service and in part replaced by T-rails, weighing forty-eight pounds to the yard, and Phœnix rails of sixty-five pounds to the yard.



THE ENGINE ROOM AT THE CENTRAL STATION OF THE LEGHORN-MONTENERO ELECTRIC RAILWAY.

The trolley line is of the usual type, consisting of No. 0 gauge bare copper wire suspended twenty feet above the cen-

tre of the track by means of cross-suspending wires and bracket arms. The trolley line is divided into four sections, each of which is fed by a special feeder line consisting of lead-covered copper cable armored with iron bands. The sec-

THE ELECTRIC TRAMWAY FROM LEGHORN TO MONTENERO, SHOWING ROUTE FOLLOWED.

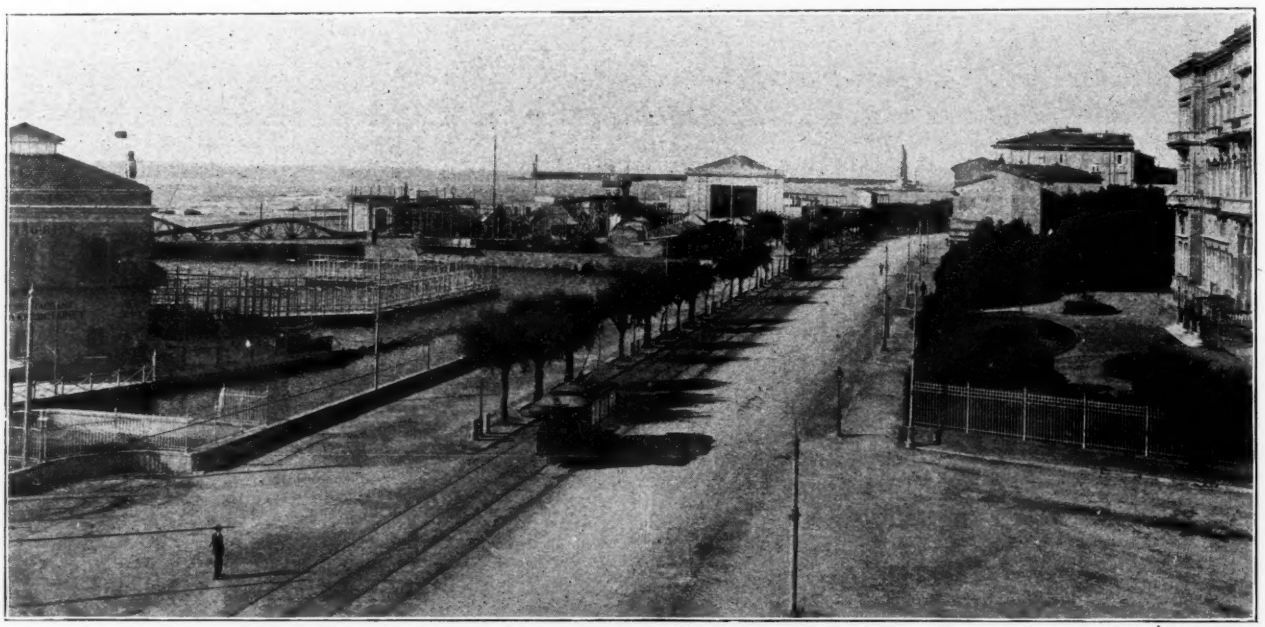
tions are further subdivided into subsections of a length of about 1,600 feet each, which are separated from each other by section breaks and switches. The rails are used as the return circuit and are bonded with heavy galvanized copper rail bonds.

The generating station is located in a building which also comprises car-sheds, offices and storehouses for the company's work. Current is furnished by three steam-driven units, each composed of a steam engine of the tandem-compound type, running at 130 revolutions per minute under 130 pounds initial pressure, coupled directly to ten-pole Schuckert dynamos, each giving 400 amperes at 600 volts. The boilers are in three batteries, each having 2,530 square feet of heating surface and working at 140 pounds. Both the dynamo and the boiler rooms are sufficiently large to contain several other units in case of extension. The boilers are of the Babcock & Wilcox type, the total output of the steam plant being 675 kilowatts. The average present load on the plant varies between 200 and 400 amperes, the generating station being thus sufficiently large to maintain an ample reserve of power against all ordinary contingencies and also to take care of a certain amount of extension of the lines.

For the new interurban line to Montenero about 150 kilowatts is the present maximum demand. The entire feeder system is overhead throughout the city.

For lighting the generating station there is a separate unit, consisting of vertical engines belted to a small 110-volt dynamo.

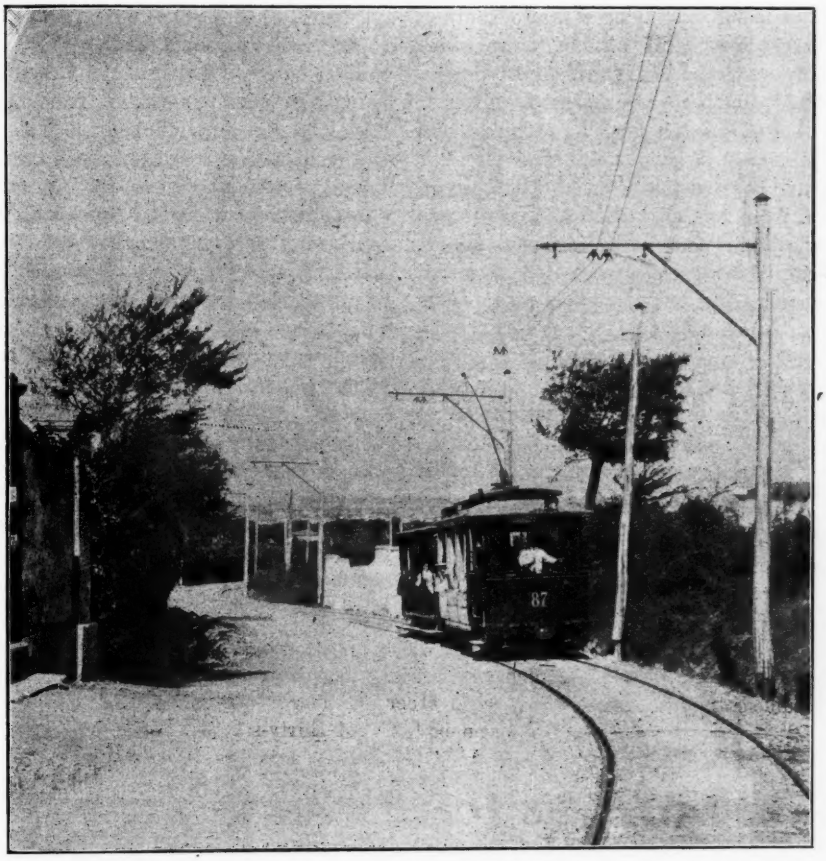
The present equipment of cars consists of thirty-six two-motor cars and twenty-nine trail cars. The rating of the motors on motor cars is twenty-five horse-power each.



THE ELECTRIC TRAMWAY FROM LEGHORN TO MONTENERO, ALONG THE WATERFRONT.

Under the old conditions of horse traffic both the horses and employés of the company often remained idle for weeks, not to say months, at a time waiting for the incoming of strangers in the summer. As a consequence of this the

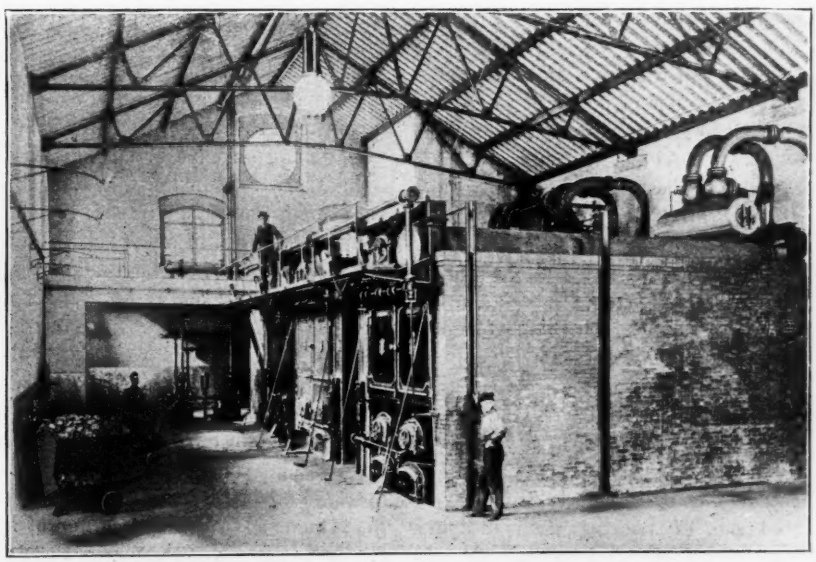
equipment rapidly went to pieces and soon became in a bad condition. Under the new system of electric traction the most gratifying results have already been attained. The accompanying illustrations give an excellent idea of the general method of construction employed, the class of streets in which the lines run, and of the cars employed upon them.



A Suburban Section of the Leghorn-Montenero Electric Railway.

The interurban line to the village of Montenero enjoys considerable tourists' patronage to this beautiful village, which is situated on the flank of the hills surrounding the city. The line runs from the Place Vittorio Emanuele in Leghorn, and a part of it, extending to the fortifications, was completed late last year and is now opened. The second portion of the line follows the provincial road and goes through the region locally known as Ardenza, the line being fairly straight and the curves of a large radius. Leaving the provincial road it ascends to Montenero by a country road and ends in that village in a "Y."

On this line heavy grades abound. Five and six per cent grades are common in the ascent to Montenero, the length of this line being almost exactly five miles, of which a third or more is on the heavy grade. It was not necessary to build new bridges for this line, as it was found possible to use those already in existence on the roads on which it runs, by means of small modifications in them. Five stations are provided on the line, at a distance of about one kilometre apart.



The Boiler Room at the Central Station of the Leghorn-Montenero Electric Railway.

The tramway lines are of standard gauge, four feet eight and one-half inches, On the Montenero line the rails are of the T-pattern of Krupp steel and weighing forty-five pounds to the yard. They are laid on oak cross-ties upon tie-plates, to which they are held down by lag-screws. The weight of the cars is only four and one-half tons per axle, and the maximum speed attained is ten miles per hour.

Current for the operation of this line is furnished by the generating station described above. Near the village of Montenero is a church which is the object of many pilgrimages, and where are held occasional fêtes. At such times as many as six trains, each consisting of a motor car with one trailer, are ascending the grade at once. The feeders for this line are of copper, rubber insulated, and further protected with tarred jute, and are carried on oak poles upon porcelain insulators. The trolley wire is double and is carried on wrought-iron brackets supported by the poles, or abutting from the houses. The line is divided into three sections for feeding and each section carries lightning arresters and manual switches. The trucks used are of the ordinary two-axle type. For the Montenero line each car is equipped with two thirty-horse-power car motors of the Schuckert variety. Each car is provided with three sets of brakes, the ordinary ratchet brake, worked by hand, electric brakes and truck brakes. The last were prescribed by the municipal authorities on account of the heavy grades on the new line and are similar to those which have been put on the tramways at Fiesole and at Settignano, near Florence. Trail cars are furnished with ratchet brakes of the usual kind. The cars were constructed by the Officine Meccaniche, of Milan, and, with a full load of passengers, weigh about nine tons each, the trail cars weighing five tons fully loaded. The new suburban line is already a gratifying financial success.

NOTES ON X-LIGHT.

BY WILLIAM ROLLINS.

NOTE CXXXVIII—TUBES FOR POWERFUL COILS.

It has been frequently said that powerful apparatus of the type shown in notes cxii and cxxxvii was unsatisfactory for exciting X-light tubes because, though it gave brilliant pictures on a fluorescent screen, the photographic results were not so good as those obtained from less powerful coils and from small static machines. To one who has always advocated more powerful generators for exciting X-light tubes this was disappointing. Some experiments were therefore made to determine why powerful apparatus did not give better results in the hands of others.

These experiments showed that the fault was not in the generators, but in the tubes commercially available, which would not bear strong discharges without the vacuums falling so far that the light was not of the proper quality for photographic work, though by means of powerful surges, which imparted a higher velocity to the subatoms in the cathode stream, the fluorescent screen could be strongly lighted. It is an axiom in physics that you can not get something out of nothing. To this, X-light is no exception.

Until we can with ease make instantaneous photographs of moving organs, like the heart and lungs, without a fluorescent screen, we should not discourage experimenters who believe in more powerful apparatus and are trying to have it adopted. No one expects to get as much light from the current used in a sixteen-candle-power Edison incandescent lamp as from that used in a fifty-candle-power lamp of the same type. It is quite as absurd to claim that as much X-light can be obtained from a small coil or static machine as from a coil capable of yielding many times as much current, for X-light can no more be evolved out of nothing than ordinary light of longer waves. We should learn to make tubes which will bear powerful currents and efficiently convert them into X-light. In former notes principles were stated which should enable this to be done. In the present note a tube constructed on these principles, which is suited to the seventy-centimetre coil described in the last note, will be described and figured. Directions for pumping will also be given, as this is a matter of importance which is not generally understood.

The tube is shown in Figs. 1 and 2. It is 560 millimetres long. The bulb is 126 millimetres in diameter. The target is placed at the actual instead of the theoretical focus of the cathode to ensure sharp definition (note i, December 1, 1897). As this focus varies with the charge on subatoms in the cathode stream (note lxxxvi, February 7, 1900), and on the degree of the vacuum (notes ii and iii, December 8 and 15, 1897; note xcvi, July 11, 1900), it is important to have the target or the cathode movable (note iv, December 15, 1897; note xix, January 26, 1898).

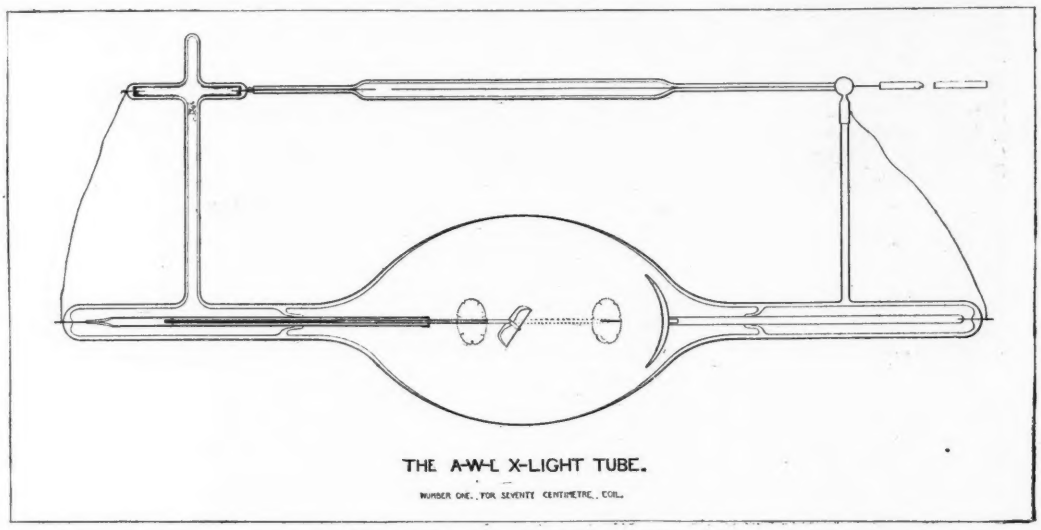


FIG. 1.—TUBES FOR POWERFUL COILS.

There are advantages in having the cathode movable, as in this case the adjustment can be made magnetically (note xix) during an exposure, because as the X-light arises from the target, if this is not moved, the radiant area is stationary, therefore the definition is good. Usually it is better to move the target, however, not attempting to make any adjustment during the exposure of the photographic plate, depending on a vacuum regulator of the type invented by Crookes, which liberates water vapor on heating, reabsorbing it again on cooling. In this way the focus of the cathode stream is kept nearly at any predetermined distance from the cathode according to the kind of light required (note vi, December 22, 1897; note x, January 5, 1898).

As a mechanical control of the position of the terminals is simpler, though not more convenient than a magnetic one, the former is shown in Figs. 1 and 2. The end of the stem of the target nearest the iridium or iridium-platinum disc is square, with shallow parallel notches on each side, the other being round. The object of the notches is to allow the target to slide loosely in the aluminum tubes supporting it, yet to prevent it from being moved from its place during an exposure by the attraction existing between the terminals (note lxvi, October 25, 1899). How strong this attraction may be was well shown in some targets with smooth stems. In one experiment the tube was so placed that the anode to approach the cathode was obliged to climb a grade of two degrees. This it would do in an hour, frequently in less time, finally coming in contact with the cathode. When the terminals almost touched, there was a bright spot whose effect upon the cathode was interesting and will be described in a future note. The end of the aluminum tube in which the stem of the target slides is covered with a thin steel cap having a square hole in which the square part of the stem fits loosely, the edges of the hole catching in the grooves in the stem of the target, which is thus held very lightly, but with sufficient security to prevent its moving during the time a photograph is being made with the tube. If at any time it is desired to change the distance of the target from the cathode this may be done by slightly shaking the tube while it is held nearly upright with the cathode end down. The object of having the stem square is to enable the target to be faced in several directions relatively to the vacuum regulator. If there is no vacuum regulator this construction is not necessary, though still convenient, as a round stem, sliding

easily in a tube, is likely to be moved out of place by the vibration imparted to the target by the impact of the cathode stream. In some earlier tubes this was overcome by bending the end of the stem, bringing it out through a groove in the sides of the tube surrounding it, but this construction is inferior to the one shown here. When it is desired to change the direction in which the target faces the tube is held in the hand with the target end up. The target then slides out of its sheath toward the cathode until the square part of the stem is free from the sheath. The target can then be turned in the required direction, the stem afterward being allowed to slide back into the sheath to the required distance from the cathode by tipping the tube until the cathode end is higher.

PROPER DISTANCE OF THE TARGET FROM THE CATHODE.

For most work the best distance of the target is that recommended in note i, or twice the theoretical focus of the concave cathode, or twice the length of its radius of curvature. In the tube shown here, this distance is eighty-six millimetres. The amount of adjustment of the target on each side of this mean point should be in a tube of the size under consideration twenty-eight millimetres.

FIG. 2.—TARGET IN TUBE FOR POWERFUL COILS.

FORM OF THE TARGET.

The target should be of the rotary type mentioned in note xi, January 5, 1899, and figured in note l, February 15, 1899. In addition to the mechanism shown in the latter note it has an automatic clamp which locks it, with the surface below any of the numbered spots, in position to receive the impact of the cathode stream. When it is desired to bring a fresh surface of the target in position it is only necessary to tilt the tube enough to free the catch when by a slight turn of the wrist, easily acquired, the desired movement can be produced. By making one arm of the catch heavier than the other the locking mechanism is effective whether the target faces up or down.

CATHODE.

The cathode and its stem are best made of aluminum as recommended by the early workers with vacuum tubes. No metal has yet been found that is better which is not at present too expensive for practical work.

The diameter of the cathode is fifty-six millimetres. The thickness and distribution of the metal are well shown in the illustration. It is desirable to have the face of the cathode smooth, therefore the stem should not be riveted on, as is still the custom; the cathode should either be turned and polished in a lathe to the proper curvature, or it should be dropped forged with a projection on the back for attaching it to its stem, as shown in Fig. 1.

Both these methods have been used. As no difference could be detected in the results drop-forging is the better, because it is cheaper, if a number of cathodes are required.

POSITION OF THE CATHODE.

It was shown in note xviii, January 26, 1898, how much the efficiency of a tube depended upon the position of the cathode relatively to the glass walls, and in subsequent notes a number of well-designed tubes were figured. An experience much longer than was possible at that time has confirmed the statements there made, one of which was that the cathode should be placed to allow it to gather up the particles in their rushing sweep toward that end of the tube. Further experience has proved that the idea of putting the cathode in an annex (Fig. 30, note xxx, August 3, 1898) to enable its concave surface to continue the curve of the tube, to aid in the gathering up process, though afterward adopted by nearly every maker after the tubes of this kind were produced commercially by Frei, in 1896, is of no practical account when powerful generators are used. It should be abandoned for it increases the risk of puncture besides making the tube more difficult to blow when large cathodes are used. The arrangement shown in the illustration, where the bulb is symmetrical, makes a tube more graceful, stronger and easier to construct.

STEMS OF THE TERMINALS.

The stems of the terminals should not be wrapped in glass, which is even at this late date the common method. They should be bare, because with powerful currents the glass gets broken injuring the vacuum by the gas liberated. Advantage of this fact was taken in some of the experiments to find a good vacuum regulator, a piece of glass being arranged to be heated when it was desired to lower the vacuum. Another disadvantage of using glass wrappings to support the terminals is that the latter get out of line, when the glass breaks, to such an extent that the tubes often become useless from this cause, from the jar of transportation or rough handling. The stem of the terminals should be made of bare metal of a diameter not less than five millimetres if made of aluminum, for if smaller they are likely to be bent, as the metal gets very soft in course of preparing the terminals. The tendency is to make tubes much too light and frail.

TERMINAL WIRES.

The terminal wires should not be less than 0.86 millimetre in diameter. They should not have the form of loops, as a sudden pull on the wires connecting the tube with the coil will frequently result in breaking the ends of the tube. The wires should project about five millimetres, the connection with the generator being made by small spiral steel springs of piano wire attached to the ends of the cables leading from the coil. In this construction the wire is at once freed before a pull of sufficient force to break the tube is exerted.

After the terminals are constructed it is of great importance to put them in an oven, heating them to a temperature of 700 degrees Fahrenheit, for an hour, to burn the organic matter and lubricating mineral oils which have collected on them from the mechanical operations through which they have passed. How important this is has been shown by experience gained in trying to get tubes made for powerful generators. The tube-makers would neglect this precaution, the necessity of which had often been pointed out to them; consequently in the operation of pumping the gas would arise from these sources to such an extent that by the time it had been removed the proper gases required to produce brilliant X-light had also been so thoroughly removed by the action of the current that the tube was dull. This is one of the most frequent causes of poor tubes.

(To be concluded.)

The total number of stationary boilers now in use in the United States was not ascertained in the last census, neither are they enumerated in the census of 1890; but the census of 1880 shows that at that time there were 72,304 stationary boilers in this country. It was estimated by *The Locomotive* (London) that on December 31, 1890, there were approximately 100,000 stationary boilers in the United States. The same authority estimates that at present there are about 170,000 boilers under insurance.

The Cost of Supplying Telephone Service.

To the Editor of the Electrical Review:

Few independent telephone men correctly answer the question: What are all the elements entering into a true and just estimate of the cost to the company of delivering telephone service? For a complete answer must suitably define and isolate and then properly aggregate all the elements entering into the cost of producing telephone service.

It is claimed that when the Bell licensee companies estimate the cost of delivering telephone service they always include a reasonable compensation for all services rendered, for dividend or interest charges on the actual investment, for loss resulting from ordinary wear and tear, as shown in regular depreciation and replacement charges, and for the necessary outlay for operation and maintenance. And many gas, water and traction companies do likewise. Naturally, the aggregate of these several sums is large, yet it is the only just and businesslike method of securing a true understanding of the cost of supplying telephone service to the subscriber.

On the contrary, local independent telephone companies rarely enter any charge on their books for the personal services rendered by directors or officials no matter how great the sacrifice of personal interests they were called upon, or were forced by unexpected circumstances to make, nor how laborious the efforts put forth or how serviceable the influence brought to bear. Yet all these personal elements of labor, influence and sacrifice, each having a market value and readily convertible into cash when expended in other lines of industry, are freely and generously given to advance the interests of the new local independent telephone organization with no thought of pecuniary return save in the prospective ultimate increased value of the property, as a whole, and a relative increase in respective holdings.

Again, on the part of many of the independent telephone companies, there is a tendency to ignore that proper classification and distribution of accounts that ensure a ready analysis of the exact financial condition of the plant, clearly mirror the ultimate as well as the current loss or gain, and show what proportion of the investment and of the earnings has gone into plant construction, plant betterment or plant replacement, and how much of each account was divided between line and equipment and subdivided between material and labor. Then there is often a decided disinclination against the opening of accounts for depreciation, interest and dividends. Yet each account is an actual necessity, if the stockholders are to know just where they stand in a financial sense. And unless they do know all these facts, how can they accurately determine that the existing rates are sufficient to cover the cost of operation and of maintenance, afford a reasonable return on the ever-increasing investment and to safeguard that investment by a sinking fund or an equitable depreciation charge.

Even after an exchange has been in service a year the depreciation charges begin to appear with companies where such accounts are properly kept. And these companies have learned that there is the depreciation that follows use, the depreciation that follows the introduction of improvements and the depreciation that follows replacements.

Now depreciation has been defined as "the actual loss upon assets which are diminishing in value, or of an estimated sum charged against gross revenue, which amount is considered sufficient to replace the capital used up or reduced by wear and tear." For "the loss or gain of an undertaking for any period is not simply the difference between receipts and expenditures during that period," nor is "the current value of a plant always the amount which has been paid for or expended upon it." And it should always be remembered "that as machinery grows older the yearly charge for repairs increases."

Another factor of material importance entering into the problem of the cost of telephone service is that of competitive warfare. Competition is always merciless, dangerous and destructive. Yet competition in telephone service is very different in character and has few of the safeguards that surround and uphold competition in other lines of industry. Merchants may compete as often as they perceive a fair chance of profit, and when the margin of profit falls too low to safely continue such competition they can cease operations and transfer their goods to a more desirable trading-point with little decrease or loss in the investment. But when the lines are completed the capital invested in a telephone plant can only be withdrawn at a heavy loss, should competition reduce the income below the cost of producing satisfactory service. For more than a third of that investment is represented in the labor expended in building the plant. And who so foolish as to desire to purchase a depreciated telephone plant in a town where bitter competition has unsettled market values? Or in what other available line of industry can old pole lines and second-hand telephone mechanism be employed?

In order to gain a strong foothold a new merchant may temporarily sell goods at cost, or even less than cost. But whoever heard of a sane merchant continuing for years to sell all of his stock or product to all of his customers at prices far below what every other merchant has long known is the safeguard of prices if a reasonable profit is to be secured? And what, think you, would be the commercial rating of such a merchant? Could he ever hope to win financial success unless he skimped in weights and measures in the same proportion as he cut his prices? And if he did skimp, how long would his intelligent customers remain?

Quite naturally such an odd merchant would draw many customers from his competitors, and for a while his daily receipts would be very large. But only the most inexperienced of merchants would delude himself into thinking that he was doing business at a profit, because his daily receipts enabled him to pay running expenses and the interest on the purchase price of the goods. If not insane, he would certainly know that sooner or later his stock of goods must be replaced if he continued in business. And then his store and equipment must be enlarged to meet the needs of the throngs that gather at his doors to share his seeming generosity.

And then—when a stock must be replaced and store enlarged—would come the day of reckoning, just as surely as it will come to the telephone company that imagines it can deliver telephone service at a price too low to provide for all the fixed charges, for extensions and for the rebuilding of its plant.

Fred DeLand.

Pittsburg, April 12.

International Association of Municipal Electricians.

The seventh annual convention of the International Association of Municipal Electricians will be held at Richmond, Va., Tuesday, Wednesday and Thursday, October 7, 8 and 9, 1902. Papers will be presented by Mr. Walter M. Petty, Rutherford, N. J.; Captain William Brophy, Boston, Mass.; Edward F. Schurig, Omaha, Neb.; Charles F. Hopewell, Cambridge, Mass.; Jerry Murphy, Cleveland, Ohio; A. S. Hatch, Detroit, Mich., and a report of committee on rules for electrical inspection and control, by Morris W. Mead, Pittsburg, Pa. In addition to the papers, Mr. Hopewell, of Cambridge, Mass., will give an illustrated lecture on fire and police telegraphs.

The Interstate Telephone Convention.

Addresses and Discussion at the First Convention of the Representatives of Exchanges in the Central and Western States, at Chicago, April 9, 10 and 11.

AS PUBLISHED in the special telegraphic despatches to the ELECTRICAL REVIEW, last week, about 500 telephone men gathered in the Sherman House on April 9, representing delegates from the states of Indiana, Illinois, Kentucky, Iowa, Wisconsin and Michigan, at least 250 of whom were practical exchange operators, the others being manufacturers and dealers in telephone instruments and kindred appliances. This meeting was for the purpose of forming an interstate independent telephone association embracing the states mentioned above.

On Wednesday Dr. I. A. Lumpkin, the president *pro tem,* outlined the object of the association and the work of the convention. After adjournment the delegates inspected the different Chicago telephone factories, the electrical supply houses and other points of interest. At the banquet in the evening, attended by over 400 persons, Mr. J. J. Nate was the toastmaster and spoke of the importance of the movement for a western interstate association which had resulted, he said, in the largest telephone convention ever held. On motion of Mr. W. E. Doolittle, a vote of thanks was tendered to H. B. McMeal, J. J. Nate, S. A. Dinsmore, Dr. I. A. Lumpkin and W. B. Burke, the members of the committee which had so effectually arranged for the convention. Toasts were responded to by Messrs. Frank G. Jones, of Chicago; C. E. Stinson, of Rochester, N. Y.; Dr. Lumpkin, and others. A banquet for the ladies who attended with the visiting delegates and numbered nearly thirty was served at the same time, and Mrs. George A. Briggs acted as toastmistress.

On Thursday morning the delegates visited the exhibits in the Sherman House parlors to which the manufacturers had contributed very liberally. On convening in regular session the first thing on the programme was the reading of a paper by Dr. C. F. Bennett, of Waterloo, Iowa. Dr. Bennett spoke on the "Future of the Business Part of Telephony." Dr. Bennett was in favor of having standard interchangeable parts and advanced the idea that some of the more forward stages of the art would be forgotten and that wireless telegraphy, it seemed to him, would go hand in hand with aerial navigation. He thought that the business features of the work, however, demanded the greatest consideration and involved the highest responsibility. He then pointed out a number of problems, as he viewed them, in the order of prominence and dwelt exhaustively with the features which the telephone properties of the future would have. Dr. Bennett spoke of the relationship between the manager and the employé of the future as worthy of much present consideration and suggested that every effort should be made to work out a plan by which harmonious and just conditions could prevail at all times.

Mr. Richard Valentine, of Janesville, Wis., read a short paper on "The Telephone Situation in Wisconsin." Mr. Valentine stated that the independent telephone business was growing in Wisconsin beyond all expectation. There are now in that state 176 independent companies, in addition to several toll lines and exchanges owned by individuals or business firms. An approximation would seem to be that there are 200 miles of copper toll line, 3,000 miles of iron toll line, 4,000 miles of iron grounded. Of toll stations there are 650, with 23,000 instruments in use. The invested capital is $2,316,875. Much the greater part of the entire growth has been within the last three years, and of the above total investment, $336,975 is represented by sixteen companies that have been incorporated since January 1, 1902. Mr. Valentine thought that an exchange in the cities of Milwaukee and Chicago was the pressing need of independent telephony in Wisconsin. He recited the overtures which the Bell company had made to the independent companies to connect with the Bell toll lines, and stated that in the past few years only two small companies had responded. The weak point in the independent movement, he thought, was the multiplicity of small companies, and believed that the time was not far distant when a move for the consolidation of the various companies in each state would be inaugurated. He also voiced the sentiment that the independent toll lines would soon be handling telegraph as well as telephone messages.

Mr. H. C. Raney, of Fairfield, Iowa, then read the following paper on "The Future of the Independent Telephone Movement:"

The development of the independent telephone business has been one of the most remarkable movements in the business world in the last decade. Twenty years ago the independent telephone, in a commercial way, was wholly unknown. And it is only within the last ten years that the movement began to assume any importance.

Unstinted praise is due the inventors and manufacturers who recognized the needs of the people, and undertook to supply that need. The manufacturers, especially, are entitled to the great credit because their work has been done in the face of the threats of the Bell monopoly, and a great risk of financial loss. Had the Bell company been successful in its litigation, then not only would the manufacturer have lost all he had invested in the business, but risked all he was worth in the way of damages.

In response to the demands of the people, and by making use of the means placed at our disposal by the inventor and the manufacturer, we have, in this short time, accomplished a great work. Whether we consider the amount of capital invested, or the service rendered, the growth of the independent exchange and toll business is most wonderful.

I know of no reliable data as to the amount of capital actually invested in the business, but it reaches into the millions, and already ranks as one of the leading lines in the business world.

When we consider the service rendered, the result is equally remarkable. Almost every village and farm neighborhood now enjoys the use and blessing of the telephone. And, at the present rate, but a few years will elapse until they become as much a part of the home as a table or a stove.

This remarkable and growing demand for the telephone is at once the guarantee of a prosperous future for the business, and at the same time the most dangerous element in the business.

It is a sure guarantee because it is the proof of a demand that must be supplied. Its danger lies in the fact that the people are almost wholly ignorant of the laws that govern the business. They are ignorant because the business is only in its beginning, and the laws governing it are not yet developed, and because the business itself is peculiar by reason of the agency employed; is not governed by the rules that govern any ordinary business. This has led to a most serious difficulty.

A great mass of the people have become possessed of the idea that telephone service can be furnished for almost nothing, and for that reason are disposed to make demands for a low-priced service that can not be complied with. The great reduction in price made by the independent companies from the old Bell rates may have something to do with the people

getting such an idea. But I think the most potent factor in bringing about this condition of affairs has been the manufacturers of cheap telephones who have sought the farmers' trade, and lead him to believe that any kind of a telephone and a fence wire would make a first-class telephone system. And the farmer finding that by this system he could carry on a conversation with his neighbor a quarter of a mile away, has accepted the idea, and is acting accordingly.

This condition constitutes one of the gravest dangers that the small operator has to face. He has invested his capital in his exchange and small toll line system; and because he will not give some set of farmers the free and unlimited use of the same, they proceed to build parallel lines and ask for a franchise, and start a competing exchange.

I think that time and experience on the part of the farmer will eventually remove this trouble, but in the meantime it may have financially wrecked the small operator.

If the independent companies engaged in the business on business principles, as a matter of investment, will but stand together and refuse connections to all companies except on a strictly business basis, the evil will be greatly minimized. It, of course, follows that the larger and stronger the independent companies engaged in the legitimate business become, the better they will be able to control the situation.

This brings us to what, in my judgment, is one of the urgent needs of the future in our business; that is, consolidation and a larger community of interest of independent companies.

I have no specific plan to offer, but leave that to others who will address this meeting. I only suggest, that I believe that this must come along the line of clearing-house associations and long-distance toll line companies, made up of the smaller independent companies.

The long-distance toll line is one of the recognized needs of the future. I do not mean the line hundreds of miles long, but lines covering distances from 25 to 150 miles. It is a recognized fact that at least four-fifths of the so-called long-distance business is done within a distance of 100 miles.

Another remedy for the evil referred to, and one of the pressing needs of the future, and one of the best means of solving the long-distance question, is improved construction and equipment. The best is not too good to ensure the future of the business, and is the cheapest in the end. Good, heavy cedar poles and plenty of them, good cross-arms, well braced and bolted on, good iron or copper wire, tightly put up and properly transposed, good telephones and switchboards, are essential to, and will ensure, good service, and good service will ensure good financial returns—the one great object of the independent telephone man.

One danger that we should avoid is asking for too much legislation supposed to be in our favor. As a rule, I think, the rights granted the telephone companies in the different states are ample. And what we need is to carefully guard what we have rather than to ask for more. If our business is properly conducted and our exchanges and toll lines properly constructed we have nothing to fear in the matter of obtaining capital to carry on our work.

Financial men have come to recognize that the telephone is a public necessity, and the fact is that telephone stocks and bonds are conceded to be one of the most reliable and satisfactory forms of business investment in the world. In an address made before a bankers' association in the East a few months ago a prominent banker said: "That telephone securities were to-day the most reliable securities in the stock market. That they were the least affected by hard times. That when times became hard, railway earnings decreased and stocks dropped in value. That even street railway earnings would decrease, because in hard times people would walk rather than ride. But not so with the telephone. Times have never become so hard that people accustomed to the use of the telephone would give it up."

Telephone companies conducted on business principles have not only brought fair and satisfactory returns from the operators' standpoint, but have come to be considered safe investments in the financial world. Such is the position that the independent telephone business occupies in the business and financial world to-day.

In a semi-official way we who are gathered here represent the vast investment made in the great central states of the West. We have a common cause and a common object, and that object can best be prompted by unity of action and effort. A survey of the field discloses the fact that the matters that we have suggested are essential to the proper development and growth of our business.

The outlook for the coming year is brighter than at any time in the history of the independent telephone companies' business. Reports from every section of the country indicate an enormous growth for the coming year. In the prosperity we enjoy as a country the telephone business will receive its full share.

Mr. L. A. Frazee, of Connorsville, Ind., made "The Telephone Situation in Indiana" the subject of a semi-humorous paper on the trials and triumphs of early independent telephone efforts in that state. He dwelt on the difficulties of gaining the confidence of investors and also of the trials undergone with respect to obtaining proper and efficient equipment. The fact that in Chicago to-day factories are turning out telephone instruments at the rate of one per minute was a source of great satisfaction to a pioneer. The growth of independent telephony was a source of congratulation, there now being approximately 4,433 independent instruments in use in Indiana. He spoke of the need for constantly renewing and perfecting the service, and explained in detail the construction of present installations in Indiana. He thought that a great amount of consideration was necessary to properly classify the service so that a universal use might be made of the telephone at rates which would be justifiable from both the operators' and the users' view-point.

Mr. E. M. Coleman, of Louisville, Ky., then made a brief address, giving the history of the Louisville Home Telephone Company. This company, he said, had 5,500 five-year contracts a month before it began to give service.

It was then moved by Mr. George N. Bandy, of Perry, Iowa, that a resolution be adopted that each state represented name two members of a committee on constitution and by-laws and also two members of a committee on permanent organization, this committee to select a president, vice-president, secretary and treasurer. The resolution also provided for an executive committee composed of one member from each state represented, this committee to be selected from the representatives from the states. This resolution was adopted unanimously. Mr. J. C. Joslin, of Sycamore, Ill., later on moved that a vote on the resolution adopted be reconsidered and a debate followed on the manner of electing officers. It was the opinion of some of the delegates that the nominations and elections should be made in open convention. A protracted discussion followed, some of the delegates inferring that the telephone manufacturers were seeking to exercise an undue influence in the matters of organization and the question of reconsidering the resolution was put to a vote and the motion to reconsider was lost by seventeen as against twenty-three. The nominating committee plan was thus allowed to stand. A recess was then taken to permit committees on permanent organization and on constitution and by-laws to meet and prepare reports.

The committee on constitution and by-laws reported organization by the election of A. L. Hutchinson, of Wisconsin, as chairman, and C. F. Bennett, of Iowa, as secretary.

The following officers were then elected:

THE OFFICERS.

President, H. C. Raney, Fairfield, Iowa.

Vice-president, Dr. I. A. Lumpkin, Mattoon, Ill.

Secretary, E. M. Coleman, Louisville, Ky.

Treasurer, J. C. Harper, Madison, Wis.

Executive committee—Illinois, Charles E. Hull, of Salem; Indiana, L. A. Frazee, of Connorsville; Iowa, George N. Bandy, of Perry; Kentucky, H. K. Cole, of Owensboro; Michigan, J. B. Ware, of Detroit; Missouri, J. W. Layne, of Carthage; Wisconsin, A. L. Hutchinson, of Weyauwega.

Mr. Raney and Mr. Lumpkin were both called on for remarks, which were well received.

"Public Confidence in the Independent Telephone Movement" was the subject of a paper by Mr. E. R. Conklin, of Aurora, Ill. Mr. Conklin outlined briefly his idea of some of the necessary elements which should characterize independent telephone operation. Public sentiment was the guide which should be followed closely, and the primary questions were: (1) Who needs telephones? (2) how to supply them? and (3) the price to be charged? He spoke of the great number of farmers' lines which were being established, and suggested that party lines should be resorted to in order to further such use of the telephone. After carefully considering the various elements which enter into every situation he believed a rate could be named with a reasonable certainty of its proving satisfactory to the public and an assurance of profit to the investor. The general and universal reports of growth and success seemed to him to be unerring evidence that independent telephone companies were in possession of the confidence of the people, and that every effort should be made to foster this happy condition.

W. H. Crumb, of Chicago, read a paper on exchange construction and J. B. Ware reported from the committee on constitution and by-laws. The constitution as adopted is as follows:

Name—Interstate Independent Telephone Association.

The Object—To promote the welfare and interests of the independent telephone companies operating in the states of Illinois, Indiana, Iowa, Kentucky, Michigan, Missouri, Minnesota, Ohio and Wisconsin, and to cooperate with and assist the Independent Telephone Association of the United States of America in its undertaking in the general independent telephone interests.

Sec. 1. Membership—Each operating independent telephone company is entitled to become a member of the association upon the payment of $5, and to one vote at the meetings of the association, but may send as many representatives of the company as it may desire.

Manufacturers and supply dealers may become associate members on the payment of $5, but shall not be entitled to vote at any meeting of the association.

Sec. 2. Meetings—Annual meetings of the association shall be held in December of each year, at such time and place as the executive committee may determine.

Sec. 3. Officers—Shall be a president, a vice-president, a secretary and a treasurer, each elected for a term of one year and until their successors are elected; shall perform the duties usual to such officers. The officers shall be nominated by a special committee from each state, appointed in each case by the delegates of each state, and shall be elected by a majority of votes. Officers shall not be elected to hold office two consecutive terms, except in case of the secretary.

Sec. 4. Salaries—No officer shall receive a salary except the secretary, who may be paid such compensation as the executive committee may determine.

Sec. 5. Executive Committee—The executive committee shall consist of one person from each state represented in the association, and shall be elected at each annual meeting by the representatives of each state selecting their own member. The executive committee shall have full powers between meetings of the association.

Sec. 6. Dues—The annual dues shall be $5 per member, active or associate.

Sec. 7. Quorum—A quorum of the association shall consist of not less than fifteen active members from at least a majority of the states in the association.

A majority of the executive committee shall constitute its quorum, and at least ten days' written notice shall be given by mail to each member by the secretary. Meetings may be called at any time on request of two members of the committee.

Sec. 8—These articles may be amended at any regular meeting of the association, notice of such amendment to be published at least twice in two electrical magazines published in Chicago, within sixty days preceding such meeting, and such amendments can be adopted by a two-thirds vote of the members present.

In dealing with the subject of "Three Problems and Their Solution," Mr. A. L. Hutchinson, of Weyauwega, Wis., emphasized his belief that the success of the business in the future depended upon the ability of the various companies to supply the demand. Growth has been so rapid in the past few years that the public and many persons connected with the business have failed to grasp its present magnitude, to say nothing of its prospective development. He considered, in order: (1) How shall the various companies secure sufficient capital to meet necessary demands? (2) how shall rates for joint business be fixed? and (3) how shall joint business of the thousand and one companies be adjusted and settled? All of these problems, he said, involved the use of either mathematics or experiment, and for some both mathematics and experiment were necessary. Mr. Hutchinson considered exhaustively the financing of such corporations and the business management of an exchange, and stated that his plans were not copyrighted—that, if approved of, any one was at liberty to utilize them; they had not been hastily conceived and were the result of much thought, study and personal experience.

Dr. H. S. Herr presented a paper on "Cost of Construction and Maintenance of Telephone Plants." This will appear in a subsequent issue of the ELECTRICAL REVIEW. This paper was fairly discussed and brought out some interesting testimony from men of experience present.

A committee was appointed to report on the subject of "What Shall Be the Attitude of This Association to the Five and Ten-Cent Toll Men" at the next meeting. Adjournment occurred Friday afternoon.

CONVENTION NOTES.

The Stromberg-Carlson Telephone Company was represented by J. J. Nate and staff.

J. H. Bunnell & Company, of New York city, was represented by V. C. Grace.

The National India-Rubber Company, of Bristol, R. I., was represented by P. F. Lyons.

The Illinois Electric Specialty Company, of Chicago, was represented by F. B. Patten.

The Warner Electric Company, of Muncie, Ind., was represented by T. W. Warner.

The Williams Electric Company was represented by Joseph Williams, Cleveland, Ohio.

The Acme Pay Station Company, of Ludington, Mich., was represented at the convention.

The Eureka Electric Company was represented by Messrs. Kusel, Stein, Canman and Hertz.

The Monarch Telephone Manufacturing Company, of Chicago, was represented by E. E. Yaxley.

The J. A. Roebling's Sons Company was represented by its western manager, George C. Bailey.

The American Electric Fuse Company was represented at the convention by F. E. Jones and others.

The Varley Duplex Magnet Company was represented by its western agent, Charles L. Hibbard.

The American Vitrified Conduit Company, New York, was represented by Bleeker L. Barnard.

The American Electrical Works was represented by Mr. Hammond, who was in constant attendance.

The Columbia Telephone Manufacturing Company entertained a number of delegates at its factory.

International Telephone Manufacturing Company was represented by Henry Schafer, the president.

The Chicago Pay Station Company was represented by Messrs. J. C. Finch and George H. Morganstern.

The Chicago Insulated Wire Company was represented by its secretary and treasurer, William M. Smith.

The Indiana Rubber and Insulated Wire Company, of Jonesboro, Ind., was represented by R. E. Lucas.

The American Toll Telephone Company, of Cleveland, Ohio, was represented by W. A. Foss, the president.

The Standard Underground Cable Company, of Pittsburg, was represented by the Chicago manager, J. R. Wiley.

The Western Electrical Supply Company was represented by G. A. Knoche, manager of the telephone department.

The Chicago Telephone Supply Company was represented by Messrs. G. A. Briggs, H. C. Randall and E. A. Petithori.

The Farr Telephone Company, of Chicago, was represented by Messrs. C. W. Farr, E. W. Hurst and John W. Bowen.

The Acme Electric Company, of Chicago, was represented by its president, W. O. Meissner, and Mr. Walsk, the secretary.

The American Electric Telephone Company made its chief exhibit at its own factory, where it entertained many visitors.

Lindsley Brothers Company, of Menominee, Mich., who make a specialty of cedar poles, were represented at the convention.

The Osburn Flexible Conduit Company was represented by several men from the office of its western agents, F. B. Badt & Company, Chicago.

The Western Telephone Construction Company was represented by Messrs. W. C. Heinroth, L. G. Bowman, W. T. Booth and A. A. Hathaway.

The Williams-Abbott Electric Company was represented by the president, Mr. Sands, of Cleveland, and the Chicago manager, H. C. Dodge.

The American Circular Loom Company, Chelsea, Mass., was represented by Thomas F. Grier, manager of the company's Chicago branch.

The Metropolitan Telephone and Electric Company, of Chicago, had an exhibit on view in the factory of the American Electric Telephone Company.

The Sterling Electric Company, of La Fayette, Ind., was represented by W. E. Doolittle, H. A. Taylor, Evan Shelby, O. P. Reed and George Metcalf.

Mr. James E. Keelyn, who is probably one of the oldest independent telephone manufacturers in the business, was in attendance during the entire convention.

The Electric Appliance Company, of Chicago, was ably represented by W. W. Low, S. A. Dinsmore, P. R. Boole, S. A. Rall, J. B. McMullin and Richard Cheney.

The American Electric Telephone Company was represented by Messrs. H. P. Blockledge, S. J. Baer and M. R. Hauptman; President P. C. Burns and General Manager Ihmsen were also in attendance.

The Swedish-American Telephone Company was represented by the president, E. B. Overshiner; assisting Mr. Overshiner were Messrs. C. H. Macklin, A. V. Overshiner, P. L. Scott and F. M. Ferguson.

The Kellogg Switchboard and Supply Company was represented by Messrs. A. E. Barker, of Cleveland; R. H. Martin, J. C. Beldon, S. A. Duval, C. P. Platt, J. C. Neely, J. C. Lewis and Kempster B. Miller.

The North Electric Company, Cleveland, Ohio, was represented by F. F. Sapp. This company has prepared a most artistic brochure for distribution at the meeting, entitled "Better Dividend Payers," containing practical telephone information of interest to exchanges.

The Automatic Electric Company, Chicago, was represented by James F. Crook. This company distributed a well-written essay on automatic telephone systems, and the company also conducted visitors through the underground tunnel now being made for the new automatic system to be operated in Chicago.

Telephone Manufacturers Organize in Chicago.

[*Special Despatch to the* ELECTRICAL REVIEW, *April 16.*]

In response to a call issued early in the week by Mr. James E. Keelyn, a number of telephone manufacturers assembled in the parlor of the Oxford Hotel on Wednesday afternoon, April 16, and held the organization meeting of the "Telephone Manufacturers' Association of the United States," which name was endorsed by those responding to the call. In the call issued by Mr. Keelyn, the primary intention of the association was announced as "harmony," and it was necessary to approve measures for the general benefit of its members not antagonistic with their individual business rights.

There were present at this meeting: Kempster B. Miller, of the Kellogg company; James E. Keelyn, of the Keelyn Telephone Manufacturing Company; I. G. Ihmsen, secretary of the American Electric Telephone Company; Frank E. Jones, president of the American Electric Fuse Company; V. H. Meissinger, E. B. Overshiner, president of the Swedish-American Telephone Company; George A. Briggs, president of the Chicago Telephone Supply Company; Arthur Stein, secretary of the Eureka Electric Company; L. G. Bowman, secretary of the Western Telephone Construction Company, and C. W. Farr, president of the Farr Telephone and Construction Company, all of Chicago, and Frank F. Sapp, of the North Electric Company, of Cleveland.

Mr. Keelyn was made the chairman of a very harmonious meeting, and a committee was appointed to report a plan for permanent organization at a meeting to be held on May 13. The committee is composed of Messrs. Keelyn, Jones, Bowman, Briggs and Procunier.

A Singular Case of Alleged Municipal Interference.

The Manhattan Fire Alarm Company, of New York city, is a concern which has been for several years in the business of installing and maintaining extension fire-alarm apparatus. This apparatus is such that small fire-alarm boxes are installed at any place that may be designated upon the premises of subscribers to the service, and upon their manipulation send in from the nearest street fire-alarm box, connected with the municipal system of fire-alarm telegraphs, the signal for that box. Their method of connection with the street fire-alarm boxes is mechanical, and no circuit attached to the fire-alarm telegraph system is in any way cut, looped or interfered with. The company has been in business for seven years, and in February of this year had in place about 2,400 stations of its system, maintained in about 900 different premises, including hotels, theatres, factories, railway stations and steamship docks, hospitals, places of business, etc.

The license of the company to do business in New York city was revoked by Mr. Thomas Sturgis, fire commissioner of New York city, on February 21, 1902. The permits granted the company in the usual routine of business had been suspended for nearly two months, but efforts made to obtain a satisfactory explanation were, it is stated, unavailing. A hearing was had on February 20, when the commissioner, it is said, requested the company immediately to show cause why its license should not be revoked. It is stated by officers of the Manhattan Fire Alarm Company that no reason was alleged why this company should have its license revoked or why any discrimination should be exercised against it when other companies in the same general line of business were not molested. The commissioner is said to have stated that in his opinion the company's service involved improper use of public property. An appeal against the action of the commissioner was taken and is now in the hands of Mayor Low.

Among the customers of the Manhattan company were the docks of seven transatlantic steamship companies, and a very large number of manufacturing establishments situated in various parts of the city and its vicinity. The carrying out of the company's contracts, as far as its customers are concerned, has been faithfully performed, and no complaint has been made that its fire-alarm system has failed to operate in cases of emergency. The action of the commissioner is regarded by the company as arbitrary, and energetic steps are being taken to prevent the suppression of its useful operations by municipal action.

Important Electric Fan Decision.

An important decision in regard to the infringement proceedings brought by the Westinghouse Electric and Manufacturing Company against the Dayton Fan and Motor Company has just been rendered by the United States Circuit Court of Appeals for the Sixth Circuit.

Suit was originally brought on an allegation of infringement on what is known as the "split-phase" patents of Mr. Nikola Tesla, Nos. 511,559 and 511,560, dated December 26, 1893. Suit was brought in the United States Circuit Court for the southern district of Ohio on February 6, 1901, and was decided by Mr. Justice Thompson, of that court, in favor of the plaintiff. The defendant company appealed from this decision, and the case just decided is the appeal in question, which confirms the decision of the lower court.

The infringement complaint relates to claims one and two of the first, and claims one, two and six of the second patent mentioned above. The principal defence set up by the defendants was a claim that the invention covered had been the subjects of a former patent to the same patentee, and that the latter patents were therefore void. The same patents, however, had formed the subject of another suit in the United States Circuit Court for the southern district of New York, wherein Mr. Justice Lacombe had decided in favor of the Westinghouse company.

National Association of Manufacturers.

The seventh annual convention of the National Association of Manufacturers was held in Indianapolis, Ind., on April 15. President Theodore C. Search, of Philadelphia, presented the annual report —now for the sixth time—and called attention to the declining exports of American manufactured products and urged manufacturers not to neglect their foreign customers in this era of extraordinary home demand.

Reciprocity formed one of the chief topics of the report, and the work of the National Reciprocity Convention, which was held in Washington last November, under the auspices of the association, was reviewed at length.

The pending bills for the reorganizing of the consular service on practical business lines were recommended for approval by the association. The attention of the association was directed to the pending eight-hour bill and the "anti-injunction bill," both of which, Mr. Search said, were of great concern to every manufacturer in the country. As a means of increasing the influence and prestige of the association, Mr. Search suggested the holding of semi-annual conventions of manufacturers and merchants for the consideration of special topics.

A Carbon Electrolytic Interrupter.

The loss of platinum in a Wehnelt interrupter by wearing away of the point in dilute sulphuric acid when large currents are used suggested the employment of a cheaper material. Fair results are obtained for a time with an anode of copper wire, well insulated except for one to one and one-half millimetres at the tip, with a lead plate as cathode, but the working is not satisfactory. Other metals and solutions have been tried with indifferent success. The critical voltage below which an interrupter fails to work properly seems to vary with different metals. Although for carbon this point is rather high, it appears to give by far the best results. A new apparatus is described, having as anode a carbon rod 3 mm. in diameter, immersed in twenty per cent potash solution in a lead jar 27 mm. in diameter and 80 mm. high, which forms the cathode and is cooled by water. Heating is also prevented by copper-plating the anode to within 1.5 mm. of the tip. The rod is enclosed in a tube with a stirrup at the bottom, and as it wears away it slides down the tube and so always exposes the same length. It is adapted for a six-inch spark coil on a 100 to 110-volt direct or alternating circuit without the use of a resistance in series. By adjusting the stirrup or the size of the rod any other spark length within the security of the coil may be provided for. A minimum direct-current voltage of sixty-five to eighty is required, and the best results are given between 85 and 110. This instrument is recommended as cheap and simple in construction, well suited for continuous work, and as acting in almost every case as well as the usual platinum form. As with other interrupters there are certain peculiarities in the spark. Experiments showed that there is no very large electromotive force of polarization in the apparatus, though there is 0.3 to 0.4 ampere "excess current from the carbon to the lead."

A wattmeter indicated a consumption of 62.5 watts for a six-inch spark, but the latter was "of much greater continuity and energy than that produced by any mechanical interrupter."—*London Electrical Times.*

Wireless Telegraphy.

To the Editor of the Electrical Review:

I see by a statement of Professor A. Slaby, under date of Berlin, April 2, 1902, that he claims he published discoveries of his system of wireless telegraphy in December, 1900.

By referring to an abstract in an electrical journal I find he concludes there is a loop at the top of the aerial receiving wire and a node at the earthed end, and he extends a wire from the end earthed until he supposes he has reached another loop the same as exists at the top of the aerial wire, and at that point places his coherer. Whether the vertical wire is divided in such a manner seems to me to be in doubt, as I know of no experiments that prove there is such a division, but be that as it may, I am sure from experiments that there are segments formed along such wires, and if the coherer is placed half way between two nodes it will be at the place of the greatest energy. A Hertzian circle has a loop at its spark-gap and a node directly opposite, which experiments fully prove.

If a grounded wire is touched to the Hertzian circle directly opposite the spark-gap, that is, at a point an equal distance on each side from the spark-gap, there is no interference with the spark. I have cut the wire at the same place touched by the earthed wire and found but little if any interference, whereas if any other part of the circle is touched or cut there is interference. I have also made experiments with Geissler tubes, proving the same as above. By referring to the Electrical Review of May 10, 1899, you will find an article, "Wireless Telegraphy," written by me, in which there is the following: "I always found the waves in long receiving wires divided themselves into segments, the greatest energy always appearing at a loop half way between two nodes, the energy diminishing each way from a loop as a node was approached and falling off to almost nothing at a node.

"If the coherer is placed at or near a node the action of the coherer would be considerably less than when placed at or near a loop."

This is the whole key to Professor Slaby's arrangement, and anticipates his publication by one year and six or seven months.

I published nothing about the construction or how to place the coherer at a loop, but claim I first published the principle of such an arrangement and believe it is the most scientific arrangement yet invented. I hope he may have great success with it, but I can not see why others may not apply the same principle, as I have prior right of publication, and it is free to all. Alfred G. Dell.

Baltimore, Md., April 3.

Reviews of Current Engineering and Scientific Literature.

Giving Concisely the Substance of Important Papers in the Scientific, Electrical and Engineering Press of the World.

THE following paragraphs give, in condensed form, the substance of the principal articles appearing in the engineering and scientific press of this and other countries. They represent simply the gist of the article in each case, having been compiled and abstracted from the original sources, to which credit is given. The journals read for the preparation of these abstracts are the principal publications in the English, French, German, Danish, Spanish, Italian and Portuguese languages. These reviews of the technical press will appear regularly in the ELECTRICAL REVIEW.

Electric Sodium Manufacture in Germany.

An article by Herr H. Danneel gives some interesting information concerning the electric sodium industry in Germany. Four establishments are engaged in the manufacture. At Bitterfeld, the Elektrochemischen Werke uses no less than 3,000 horse-power in the process, but information concerning the output of the metal is not given. Another establishment, at Rheinfelden, uses 1,600 horse-power, the resulting sodium being consumed in the manufacture of cyanide and sodium superoxide. The Castner process is used in the larger establishments.—*Zeitschrift für Electrochemie* (Berlin), March 6.

A Novel Model of Cable Insulation.

In a long paper on the insulation of cables, by Mr. Georges Claude, the author describes the ingenious mechanical analogy to the phenomena taking place in cable insulations in which there are points of discontinuity such as bubbles or grains of conducting matter. He takes up the theory of Hess, in which an element of such insulation containing a bubble, for example, may be considered as three condensers connected in cascade, the middle one being shunted by the resistance. The mechanical analogy suggested consists of two reservoirs of liquid at different levels connected by a tube in which there are two or more elastic membranes. A by-pass tube around one of these makes it quite analogous to a bubble in the insulation, and the somewhat complicated mathematical demonstration of Hess is greatly simplified by the consideration of this simple and very perfect analogy.—*L'Industrie Electrique* (Paris), March 25.

Calcium Silicide.

A very interesting note has been presented to the French Academy of Sciences by MM. H. Moissan and W. Dilthey. The history of this substance is given at length. It was prepared first by the chemist Wöhler, the discoverer of aluminum, by heating melted calcium chloride with crystallized silicon. Many years afterward it was made in the electric furnace by Chalmot. A process for its manufacture in a very pure state is described. A mixture of equal parts of pure calcium oxide and silicon is heated in a carbon tube by means of a current of 600 amperes at sixty volts. The melted mass should not remain too long in contact with the carbon tube, or considerable quantities of calcium carbide will be formed. In some experiments only 0.94 per cent of impurities remain in the finished product. The reaction takes place according to the following equation:

$$2\ CaO + 5\ Si = 2\ CaSi_2 + SiO_2.$$

This material is decomposed by water with the formation of pure hydrogen.—*L'Industrie Electrique* (Paris), March 25.

Electrical Contrivance to Prevent Collisions at Sea.

A Russian engineer, of the name of Nicholas Gherassimoff, has invented an extraordinary device for preventing collisions at sea. The object of the arrangement is to guard against collisions by driving ahead of the ship electrically propelled "feelers." These feelers are three in number, and are driven at a depth under water such that they come in contact with any obstruction at a depth less than the draft of the ship. One of them moves directly ahead in the line of the keel, and the other two move in paths to the right and left of this line respectively. The three electrical cables controlling the feelers are united at a point on board the ship in such a manner that this point and the positions of the other feelers are at the corners of a square. A cable from the junction-point is then connected with the indicating apparatus. The feelers are controlled by current from the ship, and are provided with elaborate mechanism to indicate their striking any obstruction, or their deviation in one direction or the other. Each feeler is also supplied with a luminous floating signal carried by a buoy at the surface of the water.—*Electrical Engineer* (London), March 28.

A New Method of Measuring Coefficients of Self-Induction.

In a note before the French Academy, M. Paul Janet describes an extremely beautiful method for measuring small coefficients of self-induction by the use of the singing arc recently described by Mr. Duddell. If around a direct-current arc a shunt circuit is constructed having a self-induction and capacity, respectively, L and C, under certain conditions of burning the arc gives out a sound, or musical note, having the period $T = 2\pi\sqrt{C\,L}$. By measuring, with a hot-wire ammeter, the current in the derived circuit, and with a voltmeter of the same construction the electro-motive force at the terminals of the self-induction coil, and by neglecting the resistance of the coil itself and the self-induction of the remainder of the circuit, the current is $I = \frac{U}{L\,\omega}$. Now, we already have $\omega = \frac{2\pi}{T}$. By eliminating the terms for the period of vibration between these three equations, the formula $L = \frac{U^2\,C}{I^2}$ results. This permits of calculating the self-induction by means of the purely electrical measures of capacity, voltage and current without requiring to measure the vibration period of the sound produced by the arc. Self-induction coefficients as small as 0.001 henry may be measured with accuracy and precision by this means.—*L'Industrie Electrique* (Paris), March 25.

High-Tension Transmissions in Europe.

An interesting list of high-tension power-transmission plants in Europe has

been published. At Como, in Italy, there is a 20,000-volt transmission plant under construction which will bring power to the city from a waterfall thirty-seven kilometres (twenty-three miles) distant. At Saragossa, 9,000 horse-power generated by two waterfalls is transmitted from forty-five to eighty kilometres (twenty-eight to fifty miles) at 30,000 volts. In the outskirts of Grenoble, France, 7,000 horse-power is distributed to a series of towns, among which are Voiron, Moirans and others, the total distance being fifty kilometres (thirty-one miles). On this line a pressure of 26,000 volts is used. The installation was put in service in February, 1902. At Betznau, in Switzerland, a new transmission has been put in, sending 10,000 horse-power sixty kilometres (thirty-eight miles) at 25,000 volts. In Italy an elaborate installation is in preparation on the Cellina River, where 15,000 horse-power will be developed and distributed to Venice and towns in the neighborhood. The extreme distance of this transmission will be ninety kilometres (fifty-six miles), and 26,000 volts will be used as the initial tension. All of these installations use three-phase currents, and in all of them step-up transformers are used at the generating station.—*L'Industrie Electrique* (Paris), March 25.

A New Swiss Carbide Establishment.

A new factory for making calcium carbide has been started in the Canton of St. Gall, Switzerland. Two thousand four hundred horse-power is furnished by a mountain stream and current is generated at 5,000 volts three-phase. The factory is about a mile away from the generating station, and an independent plant is provided for electric lighting. The pole line consists of iron poles set in concrete in sockets cut in rock. Every pole is thoroughly grounded, and a continuous barb-wire lightning arrester is provided for the six-wire line, as well as lightning arresters of the usual European "horn" type at the ends. Eighteen furnaces are operated, sixty volts pressure being used. The secondary conductors connecting the furnaces are of copper, a total weight of over 10,000 pounds of this metal being used for this purpose. The furnaces are of the vertical electrode type, the upper electrode being moved by handwheels and chains to regulate the length of the arc; 2,200 to 2,500 amperes of current are used in each furnace. The furnaces are not continuous in operation, having to be cooled for recharging periodically, but twelve can be kept in operation at once. The consumption of electrodes is three kilogrammes (6.6 pounds) per ton of carbide. The combustible gases produced in the furnaces are saved and are utilized for lighting the streets and railroad station of the small town of Fluma in which the plant is located.—*L'Industrie Electrique* (Paris), March 25.

An Accumulator Locomotive.

The house of Koppel, in Berlin, has recently constructed for a Frankfort establishment an accumulator locomotive weighing 5,500 pounds. This machine is provided with a four-horse-power motor, and hauls four cars, each weighing two tons, on rails at a speed of six miles an hour. The battery is composed of eighty-eight elements furnishing a maximum current of twenty-six amperes. Running light, the locomotive consumes eight amperes. It makes twenty trips in twenty-four hours, the power required being ten kilowatt-hours per day. In this establishment the cost of forage for two horses was from five to six marks per day, while the cost of electrical energy for the locomotive is only 1.5 marks. The battery is charged eight times a day at intervals between trips, one hour and a half being employed for each charge.—*La Locomotion Automobile* (Paris), March 27.

Disruptive Discharges.

Mr. K. R. Johnson has taken up the study of the conditions of the formation of disruptive discharges. The conclusions he arrives at are that a higher potential difference is required for the first discharge than for following ones, while the oscillations are more intense from the first spark than those that follow it. The intensity of oscillation augments with the striking distance. The length of waves given out augments also in proportion with their intensity. Breakdown potential differences are more regular when the negative pole of the apparatus is earthed. The potential difference of the spark he finds also to be independent of the capacity connected to the extremities of the wire.—*Eclairage Electrique* (Paris), March 15.

Liquid Chlorine Accumulator.

An extraordinary type of accumulator depends for its action upon the chemical phenomena developed between zinc and liquefied chlorine. The reaction between zinc and this liquid has been applied already to the construction of primary batteries, but not hitherto to those of a secondary type. The apparatus invented by Signor Pisca unites all the other qualities of accumulators with an electromotive force and capacity superior to that of other types, and a higher efficiency. The cell resembles a hermetically sealed battery. In a cylindrical glass jar fitted with a flange around its mouth is placed a disc of zinc from which a rod projects out through a hermetically sealed opening in the bottom of the jar. The cover of the jar is of ebonite cemented on, and this carries a threaded rod of carbon which passes down and makes contact with a carbon plate suspended a short distance above the zinc disc. Where the rod passes through the ebonite lid it is fitted with a conical screw thread, which makes a gas-tight joint. In the cover is also a hollow chamber closed with a threaded plug, and in this the liquid chlorine is introduced. To facilitate the action of the cell and increase its conductivity, a little alcohol or ether is added to the liquid, these carrying in solution zinc chloride. In operation the chlorine attacks the zinc with a formation of chloride which is dissolved in the liquid. When the solution has been fully saturated the cell may be recharged in the usual way, the chloride being decomposed, the gas returning to its liquid state, and metallic zinc being deposited upon the disc in the bottom of the jar.—*L'Elettricità* (Milan), March 30.

Telephone Call Meter.

In the new city exchange of the Post Office telephone department, in London, a system of meters for registering the numbers of subscribers' calls has been introduced. The meter rack is placed in the same room with the intermediate distributing frame. The meters are mounted in strips, ten in a strip, these being placed in panels containing thirty strips. The meter consists of a long electromagnet, from the back end of which a flat piece of soft iron is brought around near the front, and hinged to this is a soft iron armature. When current passes through the coil of the magnet the armature is drawn toward the core and moves the ratchet wheel of a registering train of gears precisely similar to the ordinary bicycle cyclometer. The indications are shown as numbers and the meters read up to 9,999 calls, when they go back to zero and start over again. The secondary contact on the meter armature is also used in this installation to light a lamp at the operator's position, thus assisting in supervision. The meters are worked apparently from push-buttons and keys at the operators' positions and are not placed in the subscribers' lines.—*The Electrician* (London), March 28.

INDUSTRIAL SECTION.

ILLUSTRATED DESCRIPTIONS OF NEW AND STANDARD ELECTRICAL AND MECHANICAL APPARATUS.

Multipolar Type Generators.

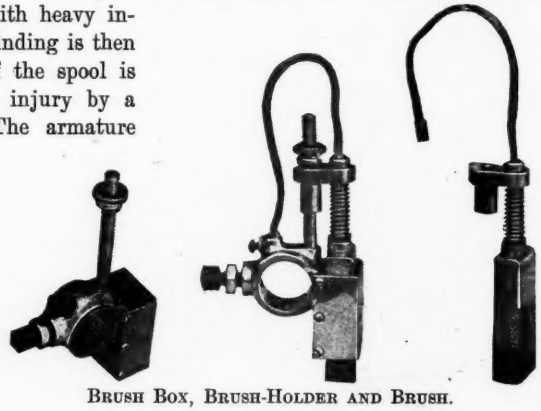
The multipolar type direct-current generator, which is shown in the accompanying illustrations, is made suitable for all classes of lighting and power service in isolated plants where comparatively small units are required. Its form in general is both pleasing and artistic, as the illustrations excellently show, and the material and workmanship entering into its construction are of a high order of merit. The manufacturers claim that these generators will carry their full-rated load at rated speed and rated voltage for twenty-four hours continuously, with a rise in temperature above the surrounding air not exceeding thirty-five degrees centigrade on the armature and field windings, and forty degrees centigrade on the commutator. They will also carry twenty-five per cent overload for two hours following a twenty-four-hour run with a very small increase in temperature above that of the surrounding air.

The field frame is circular with inwardly projecting poles all cast in one piece with the bed and pedestals. The pole faces are especially designed to produce a magnetic field in which commutation may be effected without sparking at the brushes and without shifting the brushes with changes of load. The top part of the pulley pedestal is made separable for effecting an easy and rapid removal of the armature. This is very plainly shown in Fig. 1.

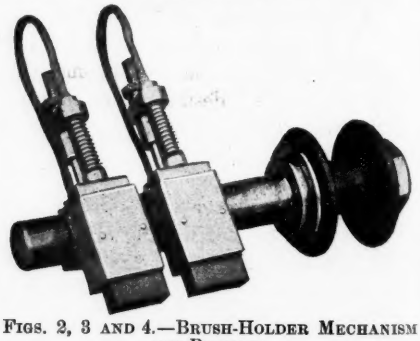
The field coils are machine-wound on heavily insulated metal spools, the shunt and compound winding being placed on the same spool. The shunt winding is put on first and covered with heavy insulation. The compound winding is then put on and the exterior of the spool is protected from mechanical injury by a layer of manilla rope. The armature shafts are made of hammered mild steel of the best quality and are very large and rigid for the various machines on which they are used. The armature core is held by bolts between heavy cast-iron flanges, which have extensions with ribbed surfaces. This ribbed surface forms air passages which are connected with a space in the centre of the core which is laminated and made from thin sheet steel of high permeability, thoroughly annealed and japanned. The armatures are all drum-wound of either round or bar copper depending on the size and voltage of the generator. The coils are continuous, without joints, and are soldered to the commutator leads. The commutators are large in diameter and the bars are deep and punched from rolled lake copper, and are insulated from each other and from the core by mica.

FIG. 1.—MULTIPOLAR GENERATOR, WITH PULLEY PEDESTAL REMOVED, SHOWING METHOD OF TAKING OUT ARMATURE.

Figs. 2, 3 and 4 give a very good idea of the brushes and brush-holder mechanism. The carbon brush is attached firmly by screws to a large metal plate to which is soldered a flexible conductor, and this is attached to a binding screw on the brush-holder box. Contact between the commutator and the brush is obtained by pressure of a small spiral spring which forms no part of the conductor circuit. The tension is adjusted by means of a self-locking thumb screw. The complete set of brushes and studs are mounted on a rocker arm which is operated by an insulated handle, which also serves to lock the rocker arm in its fixed position.



BRUSH BOX, BRUSH-HOLDER AND BRUSH.

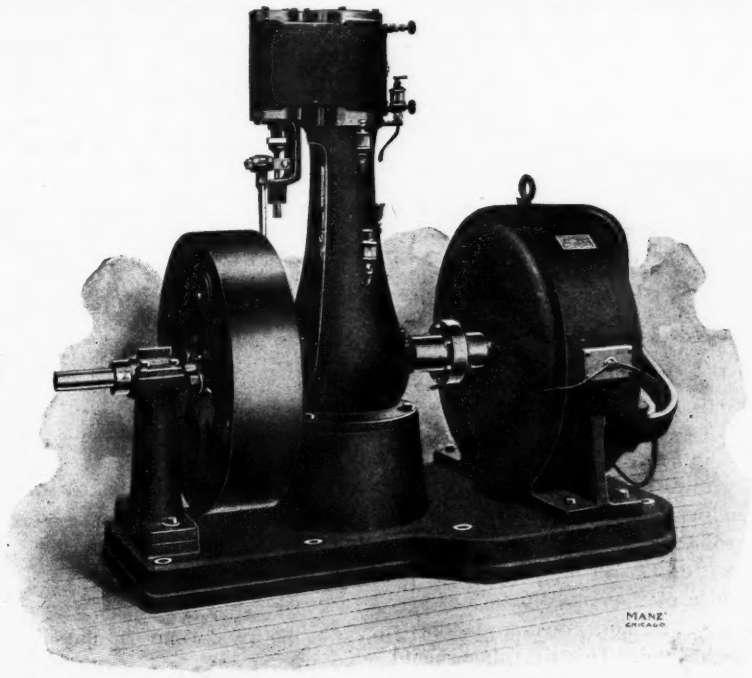


FIGS. 2, 3 AND 4.—BRUSH-HOLDER MECHANISM AND BRUSHES.

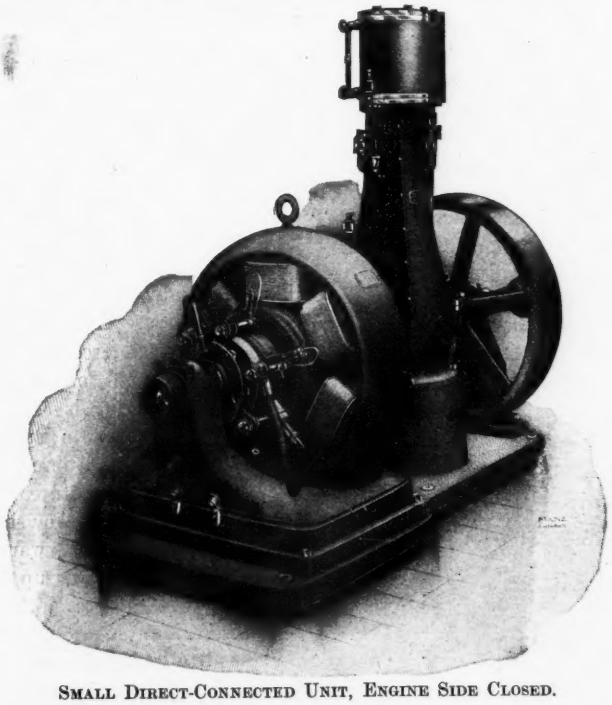
The self-oiling bearings have rings which carry a continual supply of oil from the reservoir to the spiral grooves, which allow the oil to reach all parts of the journals. These are made of metal selected for its perfect action under severe conditions of friction. The bearings in the support on the pedestal are designed to allow for expansion and contraction, preventing the cutting of the journal if the oil becomes dirty or a sufficient quantity is not kept in the reservoir. This generator and an identical type of motor are manufactured by the Fort Wayne Electric Works, Fort Wayne, Ind.

Small Direct-Connected Units.

In the automatic engines of the small, vertical type manufactured by the Racine Hardware Company, Racine, Wis., special attention is given to the accomplishment of neatness of design, compact arrangement and rigid and substantial mounting of the entire unit, so that these may be adapted for marine lighting, factory lighting, office buildings, residences and any other places where economy of space and noiseless operation are desired.



SMALL DIRECT-CONNECTED UNIT, ENGINE SIDE OPEN.



SMALL DIRECT-CONNECTED UNIT, ENGINE SIDE CLOSED.

The engine is of the piston valve type, with rings in both valve and piston. The valve and governor are perfectly balanced and all moving parts are adjustable. The crank-shaft and connecting rods are steel forgings, the crank boxes being babbitt lined, ensuring cool running and freedom from cutting. The shaft is supported by a broad out-bearing beyond the governor-wheel, which is mounted on an extended base of the engine, which, the company claims, secures perfect alignment and additional steadiness of motion.

An automatic oiling system is provided, which permits of long continuous runs, as all moving parts can be lubricated while the engine is in operation. On all direct-connected engines a shield on the generator side is furnished, which makes the engine practically enclosed and protects the armature from oil or water. The illustrations show the engine connected to two of the various types of standard apparatus.

Push-Button Flush Pocket Switch.

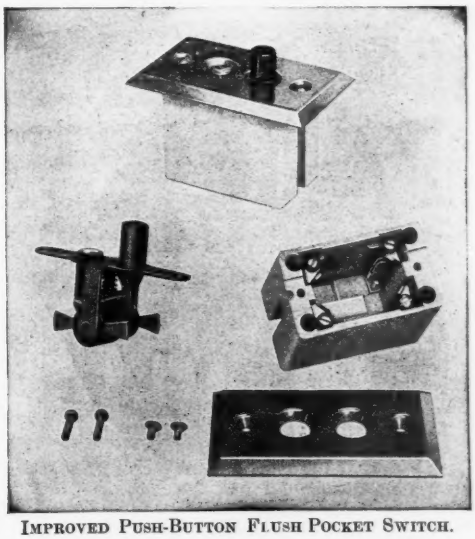
In the accompanying illustration is shown one of a complete line of single-pole, double-pole and three-way push-button flush pocket switches that are being manufactured by the General Electric Company, New York. These are designed to meet all requirements for such places where the maximum current is ten amperes, and they are suitable for use on 250-volt circuits. They can also be installed in the standard outlet boxes regularly manufactured for the reception of switches of this character.

The mechanism, which consists of an unusually small number of working parts, is entirely enclosed in a substantial porcelain box. A quick make and break is one of the characteristics of these switches and liberal contact surfaces prevent heating.

The quick positive action of the switch is accomplished by means of but one spiral spring which, with the other distinctive features of the switch, precludes any possibility of sluggish action or loosening of parts.

One of the switch-buttons is finished to correspond with the cover of the switch, while the other is black, thus a glance determines the position of the switch.

The switch may be conveniently wired from the front after being placed in position. The standard finish adopted for these switches is nickel, but other finishes can be furnished if desired. There is manufactured a cast-iron wall-pocket for use with these switches in connection with cleat or knob-concealed wiring. Separate nickel covers are also furnished for the installation of two switches or three switches.

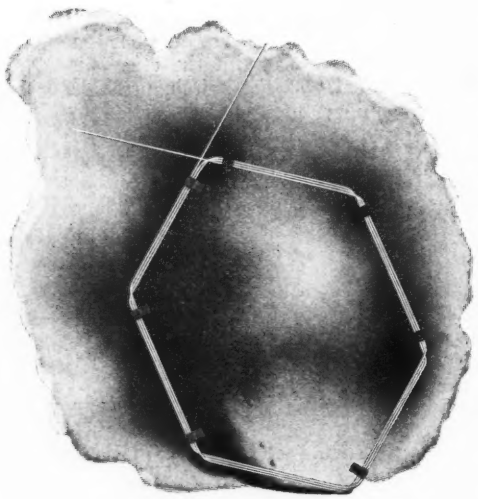


IMPROVED PUSH-BUTTON FLUSH POCKET SWITCH.

Armature and Coil Insulation by the Use of Armalac.

The well-known insulating material "Armalac," which has been used in electrical work now for more than ten years, is finding large application in the insulation of the armature and field coils of dynamo electric machinery, both in new apparatus and in repair work.

In a pamphlet recently produced by the Massachusetts Chemical Company, which manufactures armalac, and entitled "How to Insulate an Armature," some interesting and explicit directions are given for the various details of the process. Laminations are insulated by dipping them in armalac, thinned down with petroleum naphtha until a film not over one one-thousandth of an inch thick is left in drying. For large amounts of work the laminations are painted by passing them between two printers' rollers, the lower one of which runs in a trough containing the compound. Laminations so treated are completely dried in a few minutes.



Armature Coil Ready for Dipping.

Armature coils should be formed without fibre or tape and kept in shape with temporary lead clips. These coils should be baked in an oven at not over 150 degrees Fahrenheit. The oven should be ventilated so that all moisture will be driven out of the cotton and out of the oven also. More than one hour baking is not necessary. Long-continued exposure to heat carbonizes cotton fibre and nothing but harm results.

The hot coils should be taken from the oven and, without allowing them to cool, immersed in a bath of armalac. They should be allowed to cool off completely in the bath and then hung up to drip for five minutes. Then they should be reversed in order that they may dry with a thick even coat. They should not be baked. Several years' supply of such coils can be made up without fear of deterioration.

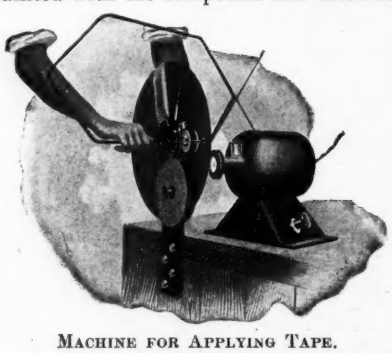
After putting any desired fibre on those portions of the coils which enter armature slots they should be wound with armalac tape, which is dry cotton thoroughly impregnated and coated with the compound

Tank for "Armalac."

by specially designed apparatus. The company treats any desired thickness of quality of cloth and cuts it into tape and also furnishes aluminum bobbins for fast hand-winding.

The coils are then heated in the oven for fifteen or twenty minutes to cement the armalac of the first dip to the tape, and then, while hot, are dipped quickly in the compound. This time they should not be allowed to cool in the tank. The object of this final dipping is to close pinholes and air spaces in the tape-winding. A thin even coat is desirable and is easily obtained by a careful workman. Coils so insulated are said to occupy the least possible amount of space, are not broken down and cracked by the rough handling of assembling and have a large margin of safety in insulation resistance.

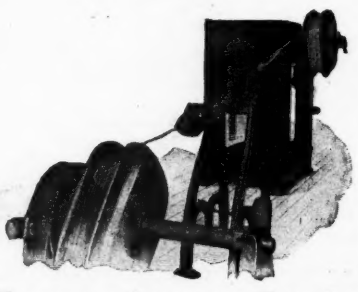
The following method of making a quick repair job with armalac in situations devoid of the facilities of a fully equipped repair plant is recommended. The short-circuited coils should be replaced with armalaced coils. These coils should be thoroughly heated, painted with the compound and dried for



Machine for Applying Tape.

a few minutes over any obtainable source of heat. The armature may then be dried out by connecting it with a motor which is running under a heavy load and heating it thoroughly with the current, or a temporary oven may be rigged up. When thoroughly hot it should be disconnected and turned over and over in a shallow wooden box containing enough armalac to give the armature a thorough soaking. The armature can be kept on a pair of wooden horses during the whole operation. It should be allowed to drip fifteen minutes, still being turned over and over, and then put in place. Start it up at once. The load should be put on slowly and the speed should be kept down, but a 150-horse-power armature so treated may safely be brought to full load and speed in one hour from the time of starting and will not throw out enough to cause the least trouble. There is said to be no chance of failure if care is used and often much money can be saved by doing a two weeks' repair job this way in a single day.

Armatures insulated by this system can



Machine for Reinsulating Field Coil Wire.

be taken apart and reassembled. The old coils should be warmed up in the oven and dipped in the compound bath. If a machine is to be shipped a long distance, or is to be laid aside for awhile, the commutator may be painted with armalac which will prevent the corrosion frequently seen on commutators. The paint can easily be washed off the face of the armature with naphtha. After armatures are completed they should receive a final coat of armalac, painted on and not baked. Unnecessary baking is expensive and a source of injury, not to the compound, but to the cotton and fibre. It is recommended that when armatures come in for repairs of any sort that they should be warmed up and dipped while warm in the tank of armalac. This fills up holes and weak spots caused by deterioration of cotton and fibre. Many "rotten" armatures are claimed to be kept in service by systematic baths in this compound.

The booklet gives instructions for making dipping tanks, for special treatment of overheated field coils, etc. It is now in the second edition, is printed in French and German and is mailed free upon request.

A Novel Propelling Mechanism for Vehicles.

A decided novelty in the method of application of driving power for propelling vehicles is that designed by Mr. George G. Fackler, of Lorain, Ohio. The inventor transmits the power of a motor to a grooved wheel inside the rim of an ordinary pneumatic-tired rim, which is utilized as an endless track for the propelling wheel, as shown in Fig. 1. The entire weight of the rear part of the carriage rests on the driving wheel and furnishes the necessary amount of friction to overcome the inertia of the load. The chief claim of the invention consists in the provision of the rim on which the propelling device can travel without coming in contact with the ground.

Referring to the drawings, Fig. 1 shows the play that the mechanism has inside the wheel. This is much or little according as the application of the power is greater or less, but is always supposed to allow the road rim to mount an ordinary obstruction and the inventor claims almost entire suppression of vibratory motion. Fig. 2 shows the traction wheel as it travels on the road rim. Guide wheels, used to keep the mechanism securely inside the rim, are shown at 8, 9 and 10. The power is applied directly by means of the shaft, 14. The method of applying the power is preferably from an electric motor. The springs which take up the vibratory motion and the manner in which the load is carried are excellently shown in the accompanying illustration. The inventor claims that the wear of the tire is reduced to a minimum by reason of its not slipping and by reducing its tendency to skid, and another advantage is stated to be the roller motion which is secured through the traction wheel directly connected with the motor without the use of differential or compensating gears.

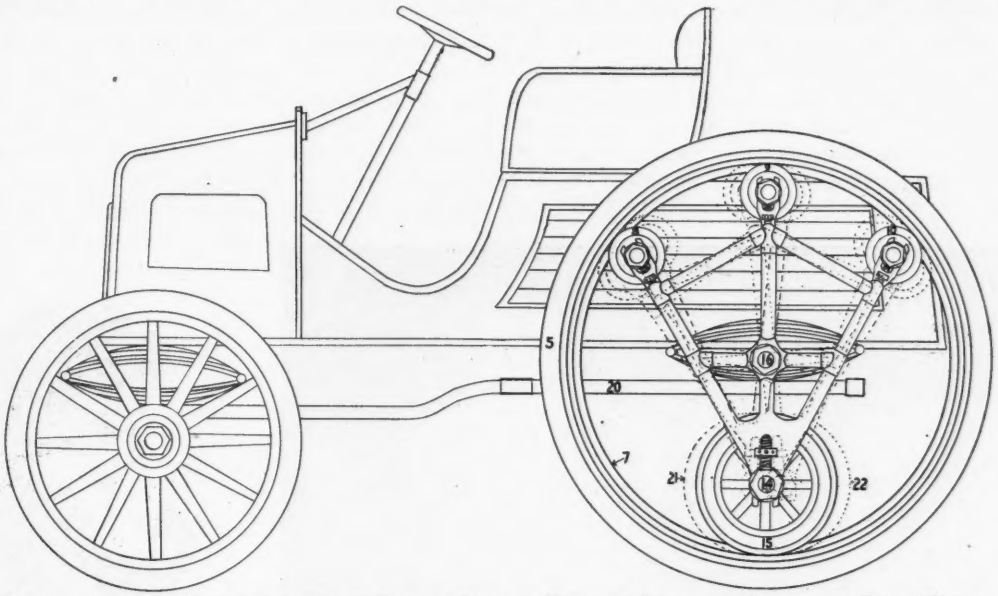


FIG. 1.—A NOVEL VEHICLE PROPELLING DEVICE, SHOWING TRACTION SCHEME AS APPLIED TO REAR WHEEL.

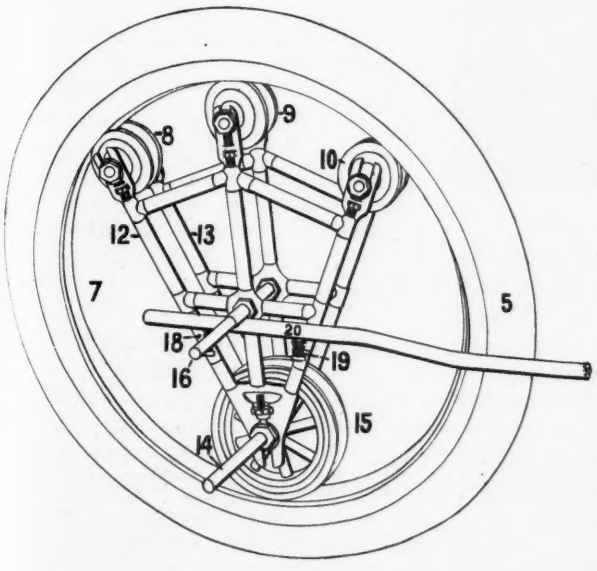


FIG. 2.—SHOWING TRACTION WHEEL AS IT TRAVELS ON THE ROAD RIM.

A Cylinder Dust Bellows.

The Smith-Hemenway Company, New York city, is introducing a cylinder dust bellows which, it is expected, will prove of very great value in the factory, machine shop and in telephone or telegraph establishments. Any place that can not be reached by a brush can be cleaned with this cylinder dust bellows, the compressed air being forced into narrow crevices, removing all particles of dust from inaccessible places.

These bellows are carefully made, the wood used in the manufacturing taking two years to prepare. They have no metal mountings, and, in the case of telephone or telegraph exchanges or about dynamo mechanisms, a short-circuit is impossible while cleaning. The principal advantage appears to be the absence of any possibility of damaging the article to be cleaned, as the employment of force would be according to will, and the direction of the air projected being at all times under positive control.

AN IMPROVED CYLINDER DUST BELLOWS.

An Interesting Paper.

TO THE EDITOR OF THE ELECTRICAL REVIEW:

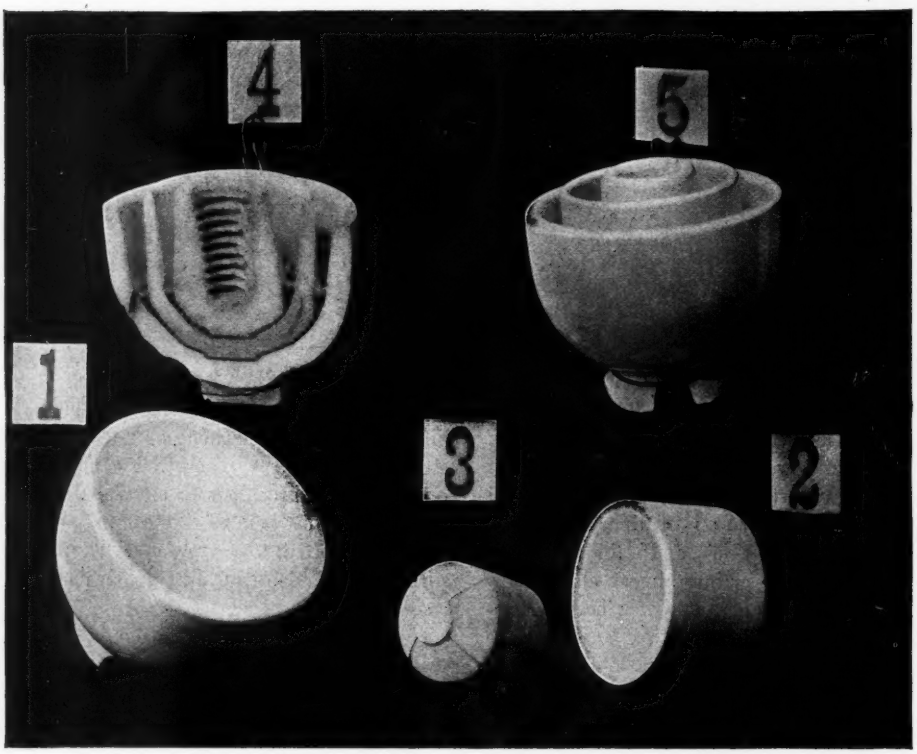
Please find enclosed check for subscription for ELECTRICAL REVIEW to January 1, 1903. I appreciate your interesting paper and wish you still greater success.

EVERETT B. BLAKE.

Life-Saving Service,
Chincoteague Island, Va., March 14.

A New Glaze-Filled Insulator.

It has been generally conceded that porcelain has an advantage over glass in respect to mechanical strength for insulators for high-tension transmission lines, the difficulty having been in making high-voltage insulators of porcelain to keep it uniformly free from flaws, and when this has been accomplished it will appear that porcelain insulators will possess advantages peculiarly their own over those of glass.



NEW GLAZE-FILLED INSULATOR, SHOWING METHOD OF CONSTRUCTION.

R. Thomas & Sons Company, of East Liverpool, Ohio, claim that their manager, Mr. J. W. Boch, has accomplished the task of producing a flawless porcelain insulator of high insulating qualities, as well as of great mechanical strength, in his "glaze-filled" insulator. During the past few years, on high-tension lines all over the country, this insulator has been put into practical use, and has met with singular success. Mr. Boch's patent on this insulator has recently been sustained by the United States Circuit Court.

The invention is based primarily upon the fact that a thin piece of clay will mould and vitrify better than a thick one, and it is for this reason that Mr. Boch builds up his insulator out of two or more shells nested together. Referring to the illustration, Figs. 1, 2 and 3 show the three shells with which Mr. Boch makes up the triple petticoated insulator. The inner piece (3) is moulded with a suitable threaded socket (4) for the usual pin. The outer shell (1) is provided with the usual notched head for the conductor, and like the intermediate part (2) is made bowl-shaped, so that the three are relatively thin shells, to be nested into each other.

In making these insulators, these separately moulded parts are first dried out separately in an oven or kiln in the usual manner. The parts are then coated with glaze all over, and are fitted into each other and stood upside down, extra glazing material being supplied at the joints in the annular channels between the petticoats. The separately moulded shells are thus welded together with thin seams of glass-like glaze, and this welding has been found to be of so tenacious a character that the insulators can be broken less easily along the lines of the "glaze-filled" seams than elsewhere.

The completed insulator is shown in Fig. 5, Fig. 4 showing one cut in two, and this excellently shows the three shells and the intermediate glazed fillings which add to the electrical insulating qualities of the insulator as well as to its mechanical strength.

Breast-Plate Transmitters.

For a number of years all the larger switchboards sent out by the L. M. Ericsson Company, Stockholm, Sweden, have been equipped with the breast-plate transmitter, and it has been successfully demonstrated that very quick service can be secured by their use.

The swinging transmitter can not be placed very near to the operator's mouth as it would then be in the way in the case of a reach for a distant jack. One hand is therefore employed a greater part of the time in holding the transmitter in proximity to the mouth. As seen in the illustration, the mouthpiece on the breast-plate can be adjusted to suit the operator, and is always in position whether the operator is sitting, standing or reaching out at one side.

BREAST-PLATE TRANSMITTER.

The apparatus is made up in a substantial and thorough form. All metal parts are of aluminum to ensure lightness, and a silk elastic strap with adjustable buckle allows the set to be fitted so as to suit any operator. The New York city office of the Ericsson Telephone Company is at 296 Broadway.

An Interesting Compendium.

[*The Telegraph Age.*]

The Twentieth Anniversary Number of the ELECTRICAL REVIEW, New York, Charles W. Price, publisher, made its appearance February 15. The issue constituted a bulky volume and was an interesting compendium of much that is of value to the electrical fraternity. Not the least interesting of its pages were those reproduced from its first number. The advances made in the single feature of illustration were clearly shown by reason of marked contrast. Mr. George Worthington, well known to electricians a quarter of a century ago, founded the ELECTRICAL REVIEW, and the presentation of a full-page engraving testifies to his appreciation by the present publisher of that journal.

CURRENT ELECTRICAL NEWS

COMMERCIAL NEWS

DOMESTIC AND EXPORT

A NEW TRACTION COMPANY—The Hudson River Traction Company, with a capital of $1,500,000, has been incorporated in Trenton, N. J. The concern is empowered to dig tunnels, construct and operate railways, etc. The incorporators are: Samuel B. Lawrence, Herman C. Everdell, New York, and George B. Hanford, East Orange, N. J.

INCREASE IN HAVANA RAILWAY STOCK—The shareholders of the Havana Electric Railway will meet on April 30 to vote on a proposition to increase the capital stock of the company from $11,000,000 to $12,500,000, by the issue of $1,500,000 common stock. It is also the purpose of the meeting to make a consolidated mortgage securing $10,000,000 of the bonds.

EXTENSIVE SYSTEM FOR FLORIDA WEST COAST—Application has been made at Tampa, Fla., for a charter to build a street electric light plant in Tampa, and construct 200 miles of trolley lines over South Florida with Tampa as a centre. The Tampa Municipal West Coast Development Company, with a capital of $1,000,000, is the projector of the scheme.

NICARAGUA LIGHTING CONTRACT AWARDED—It is reported that a New Orleans firm has received a contract for electrically lighting the principal cities of the Republic of Nicaragua. The concession from the officials of the Nicaraguan Government includes the cities of Managua, Granada, Mesaya and Leon. It is believed that the water-power between Lake Managua and Lake Nicaragua will be used as soon as the necessary power generators can be installed. A temporary steam-power plant will be erected for immediate use, however. The company will sell its current for the lighting of private residences and stores, as well as municipal purposes.

THE SLABY-ARCO WIRELESS TELEGRAPHY—The trial experiments which were made in the harbor of Kiel of the Slaby-Arco and Braun systems of wireless telegraphy resulted in favor of the first-named system. There are forty-three vessels in the German marine fitted with the Slaby-Arco apparatus, and it is believed in Germany that the whole German fleet, naval and mercantile, will be fitted with such instruments. The Slaby-Arco system is controlled by the Allgemeine Elektricitäts-Gesellschaft, and the Braun system by Siemens & Halske, both of Berlin. An illustrated pamphlet describing in detail the advantages of the Slaby-Arco system, together with an exact description of the different apparatus, will be furnished on application to those who wish to inform themselves on the subject, by the Allgemeine Elektricitäts-Gesellschaft.

A NEW CANADIAN POWER COMPANY—A new company, to be known as the Dominion Power Company, with Charles D. Warren, Charles Ritchie, Robert Davies, Allan H. Royce, Hugh Sutherland and Allan W. Ballantyne, of Toronto, as directors, is said to be petitioning for powers to incorporate a company to produce, generate and transmit electric and hydraulic power for lighting, heating, motor and other purposes; and also to run an electric railway between Niagara Falls and Toronto. The company will have a capital of $5,000,000, and proposes to secure power from the company which is now putting in an extensive plant on the Canadian side of the Niagara River. It is expected that this will be merely a transmission company, although the necessary privileges to generate electricity will be asked for. The Niagara, St. Catherine's & Toronto Company has now twelve miles of railway in operation between the Falls and St. Catherine's, and there is an open stretch of twelve miles between St. Catherine's and Beamsville. Plans are now under way to build a stretch of road between Burlington and Mimico, and it is part of the plans of the new company to connect up these strips of road already in operation.

NEW BRONX TROLLEY LINES—Extensions and improvements that will cost over $1,250,000 have been authorized by the board of directors of the Union Railway Company for its trolley system in the Borough of the Bronx. Work will begin at once and every possible effort will be made to push it to a speedy completion. Among the most important lines that are to be rebuilt at once are the Third avenue line from 128th street to Fordham, the West Farms branch from 144th street to the Bronx River, Westchester avenue from Third avenue to Prospect avenue, and the 138th street crosstown line from the north and of the Mott Haven Canal to Port Morris. The old-fashioned six-inch rails, which are now used on all of these branches, will be torn out and replaced with nine-inch, sixty-foot, 103-pound rails. New branches will be constructed on St. Ann's avenue and the Southern Boulevard to the junction of 161st street and Third avenue, on Morris avenue from 138th street to 161st street, and from the Fordham landing of the New York & Northern Railroad across the borough to Fordham. Another extension of improvement is that of the Sedgewick Avenue line from its present terminal in Highbridge to Morris Heights, this extension forming a connecting link in the western section of the city and completing a loop from the junction of Third avenue and 161st street by way of Highbridge and Morris Heights across Parkside avenue and directly east of the terminal at West Farms, crossing all other lines of the system. Extensions covering several miles are contemplated in the city of Mount Vernon and the village of Pelham Manor; and it is also proposed to complete an extension in New Rochelle so as to connect with White Plains by way of Scarsdale over and through North street in New Rochelle. In addition to these extensions numerous improvements to rolling stock, terminal facilities, etc., will be made.

TELEPHONE AND TELEGRAPH

RICHMOND, VA.—The Spotsylvania Telephone Company is extending its line from Lewiston to Childsburg and from Post Oak to McHenry.

CANTON, OHIO—The Canton Board of Trade has made a proposition to buy the stock of the County Telephone Company Exchange, an option of $250,000 having been taken.

UVALDE, TEX.—Dean & Son have contracted to construct a long-distance telephone line from Uvalde to Rock Springs, also from Uvalde to Carrizo Springs. This line will take in the towns of Laguna, Montell, Barksdale and Rock Springs, north, and Batesville, Loma Vista and Carrizo Springs, south.

ATLANTIC CITY, N. J.—The Delaware & Atlantic Telephone Company has begun laying wires in conduits on a number of avenues in accordance with the ordinance recently passed by the city council. It is expected that the electric lighting companies will shortly follow the lead of the telephone company.

KANSAS CITY, MO.—The Home Telephone Company has applied to the board of public works for its approval of the company's underground wire system, which includes in the uptown territory the district bounded by McGee and Washington and Third and Thirteenth; in the West bottoms by Ninth to Fourteenth, Santa Fe to Liberty.

CLARKSHILL, IND.—Eighteen cooperative companies in the northern district of the farmers' telephone system, through their representatives, have held a meeting to consider negotiations pending connection with La Fayette and Lebanon, and for better and more permanent connections with Frankfort and Crawfordsville. The negotiations have been pending for some time, and it is understood that the independent companies are now willing to connect with the farmers' systems.

MILWAUKEE, WIS.—It is said that the Badger State Telephone Company will this year extend its line from Delavan by way of Rochester to Racine. The company now operates in Dane, La Fayette, Green, Rock and Walworth counties, with a committee made up of residents from each of these towns as a board of management. The headquarters of the company will probably be Janesville. The Wind Lake Farmers' Telephone Company is another corporation in the vicinity of Milwaukee which has been formed for the purpose of obtaining connections with the outside counties.

ST. PAUL, MINN.—Work has begun in St. Paul upon a telephone tunnel which is to connect the Minneapolis and St. Paul systems of the Northwestern company, and through which all the interurban wires of that company will be conducted. This is designed to obviate the possibility of an

interruption of the interurban service because of storms, and will also give the company increased capacity between the two cities. This change will involve an expenditure of approximately $100,000. Altogether the company will expend $500,000 in the Northwest this year in betterments of its plant. A large portion of this will be spent in extensions of the present underground systems in Minneapolis and St. Paul, and additions to the pole systems now under way will cost $100,000 more. Additional pole lines will be constructed and many improvements will be made on the various systems owned by the company in northern Minnesota and the two Dakotas.

ROCKLAND, ILL.—The independent telephone companies, which have secured franchises in the three cities of Rockland, Moline and Davenport, have merged their interests generally under the management of the Union Electric Telephone and Telegraph Company. This company has been granted a franchise to establish systems in these three cities, and the arrangements for active work of construction are under way and will be prosecuted vigorously so that the exchanges in the three cities will be in operation by early fall. The plan contemplates the installation of an exchange in Rockland, equipped to accommodate 1,500 subscribers, the Moline exchange having accommodations for 1,000 and the Davenport exchange for 2,000. It is expected that the total cost of installing the plants will be about $300,000. The work will necessitate the building of about eight miles of conduits in the three cities and the use of 150,000 feet of cable. The equipment will be of the most modern description.

AUTOMOBILE NOTES

CLUB ATTENDANT FOR AUTOMOBILES—The Automobile Club of America has announced that there is now on duty at the club, 753 Fifth avenue, New York city, an attendant to take charge of automobiles that may be left on Fifty-eighth street. An electric bell has been placed at the east side (facing Madison avenue) of the porte-cochère leading to the ladies' entrance of the Plaza Bank. On ringing this bell the attendant will come to the sidewalk.

LONG ISLAND AUTOMOBILE CLUB ENDURANCE TEST—The Endurance Test Committee of the Long Island Automobile Club has made the following important announcement: Under non-penalized stops, are included those stops due to tire troubles, under the following restrictions: (*a*) Tires are to receive no attention until they shall have become deflated, and it is apparent that further running in that condition shall prove destructive to either the car or tire, and (*b*) one hour shall be allowed as non-penalized time for such repairs; any time consumed in excess of sixty minutes during the entire run shall be subject to full penalty. Electric vehicles are to be allowed a total of sixty minutes for either recharging or relaying batteries. Any time in excess of a total of sixty minutes during the entire run will be subject to full penalty.

ELECTRIC RAILWAYS

INDIANAPOLIS, IND.—It is reported that the Union Traction Company is working on a scheme for connecting Indianapolis with Chicago by an electric railroad system, which is to touch Noblesville, Tipton, Kokomo and Logansport.

PUEBLO, COL.—Plans have just been made public for a street and interurban railway system for Pueblo, which includes the line through the Arkansas Valley to La Junta connecting intermediate points. It is believed that it will involve the expenditure of about $1,000,000, but it is stated that the parties conducting it have ample funds to at once carry out the project.

LEBANON, ILL.—The Secretary of State at Springfield has been notified of the consolidation of the Belleville & Suburban Railway Company and the East St. Louis Electric Railway Company with the Belleville Electric Railway Company and the East St. Louis & Suburban Railway Company. There has also been an increase of capital stock from $300,000 to $2,975,000.

NORWALK, OHIO—The Sandusky, Bellevue, Monroeville & Norwalk Electric Railway, which is being built by Philadelphia capitalists, was granted an extension of franchise by a specially called session of the council, to June 1. The machinery for the power-house, boilers, dynamos, etc., is ready for shipment and the cars have been built and lettered, and the company is making every effort to complete the road as soon as possible.

LOUISVILLE, KY.—A fanchise granting the right of way for a railway other than one operated by steam, between Louisville and Mount Washington, has been bidden in by Mr. Payton N. Clark on behalf of residents on and in the vicinity of Dalton Pike, along which the proposed route will run. The purchase of the franchise makes practically certain the construction of an electric line between Louisville and Mount Washington.

ELKHART, IND.—Elkhart capitalists are preparing to build an electric line from this city to Nappanee, twenty miles in length, to bring into communication territory containing 10,000 village and country people. The Michigan Hydraulic and Electric Power Company is also petitioning for a franchise to build an electric line from Elkhart to Kalamazoo, but the matter is being held in abeyance until the route of the Elkhart interests has been decided upon.

NEW ALBANY, IND.—The New Albany, Jeffersonville & Sellersburg Rapid Transit Company will at the next meeting of the city council ask for a right of way over one of the streets to reach the business centre of the city. The company filed articles of incorporation several months ago. Louis Scheneck, of Seymour, is president. Judge J. H. Stotsenburg, of this city, George Holzbog and George H. Voigt, of Jeffersonville, are members of the board of directors. Nearly all the right of way has been secured and it is said the construction of the road will be begun this spring.

ELKHART, IND.—The Michigan Hydraulic and Electric Company, of Coldwater, Mich., has asked the Elkhart city council to grant it a franchise for an electric street railway to enter the city from the east and connect with the Big Four and Lake Shore steam railways and the Indiana Railway Company's interurban electric lines. The Michigan company—of which the officers are: President, A. J. Roate, of Kingston, Pa.; secretary, Robert Van Schoick, of Scranton, Pa., and manager, Dr. Stewart, of Coldwater—proposes to connect Kalamazoo and this city, passing through Schoolcraft, Coldwater, Sturgis and other Michigan points and Bristol.

NEW INCORPORATIONS

HARRISBURG, PA.—Mechanicsburg Light, Heat and Power Company. $20,000.

CHICAGO, ILL.—Keokuk & Hamilton Water Power Company, Hamilton. Capital stock, $2,500 to $5,000.

DES MOINES, IOWA—Turkey Valley Telephone Company; $10,000. Lee County Telephone Company, Ft. Madison; capital, $1,200. Farmers and Merchants' Mutual Telephone Company, Ottosen; $10,000.

TRENTON, N. J.—The Trenton Heat and Power Company. $500,000. Incorporators: Edward Murray, city clerk of Trenton; Charles A. May, president of the water board; Charles H. Baker, former tax receiver, and John H. Backes.

DENVER, COL.—Pueblo Interurban Railway and Power Company, Pueblo. $500,000. Directors: James B. Orman, E. G. Middlekamp, Andrew Park, A. P. Busey, O. E. Clark, Frank Finney and M. G. Saunders. To build a line from Pueblo to La Junta.

ALBANY, N. Y.—The Stromberg-Carlson Telephone Manufacturing Company, of Rochester. $3,000,000, of which half is preferred stock. Directors: Alfred Stromberg, Androv Carlson, Charles A. Brown, of Chicago; Eugene H. Satterlee, of Pittsford, N. Y.; Thomas W. Finucane, Frederick Cook, Charles E. Angle, W. B. Duffy and John C. Woodbury, of Rochester.

SPRINGFIELD, ILL.—The Chicago & Milwaukee Electric Railroad Company; $300,000; the incorporators and first board of directors are: Albert C. Frost, George M. Seward, Charles B. Wood and Horace S. Oakley, all of Chicago, and Joseph W. Maulk, of Highland Park. The Lawrenceville Light and Water Company, Lawrenceville, certified to an increase of capital stock from $25,000 to $32,000.

JERSEY CITY, N. J.—National Telegraphone Company, principal office, 83 Montgomery street, Jersey City, N. J.; object, manufacture telegraphones; capital, $2,000,000; incorporators: Edwin L. Granel, Geo. E. Milligan, Allen E. Kilby. Union Railway Power and Electric Company, principal office, 243 Washington street, Jersey City, N. J.; object, manufacture electric power; capital, $100,000; incorporators: Nelson R. Vanderhoof, W. M. Greene, Edward Cuddy. C. K. Manufacturing Company, principal office, 15 Exchange place, Jersey City, N. J.; objects, manufacture electric motors, etc.; $50,000; incorporators: Frederick F. Leavens, Chas. H. Langdon, Jr., Arthur F. Stanley.

ELECTRICAL SECURITIES

Dealings averaged something like a million shares each session of the New York Stock Exchange last week, which was the most exciting so far this year. Although the continued bullish sentiment prevailing has attracted some increased public interest, the market lacks very much in this one element of strength, and the larger commission houses still complain of poor business.

Money holds firm and crop returns are highly favorable, with the spring planting presenting the probability of a splendid yield. There is, however, no real foundation for the recent animated bull campaign, other than the ordinary prospect of good times. The pending application of the state of Washington to bring the case of the Northern Securities Company directly before the Supreme Court is of interest, as it makes possible a much earlier final decision than in the suit brought by the Federal authorities in the lower court.

The report current that negotiations leading to the termination of the war in South Africa has had a strengthening effect on the London market.

ELECTRICAL SECURITIES FOR WEEK ENDING APRIL 12.

New York:	Closing.
Brooklyn R. T.	65
Con. Gas	224½
Gen. Elec	331
Kings Co. Elec	199
Man. El	133½
Met. St. Ry	152½
N. Y. & N. J. Tel. Co	169
Telep., Tel. & Cbl. Co	5
Westinghouse Mfg. pf	226½

General Electric reached the high-record mark of 334. As has been noted before this has been a most prosperous year for this company. Westinghouse Electric made a sensational gain of 19 points. The simultaneous rising of these two companies has started anew the rumors of a merger of interests, but so far there has been nothing but denials from authoritative quarters.

Boston:	Closing.
Am. Telep. & Tel	183
Edison Elec	267½
Mass. Elec. pf	96¾
New England Tel	149
Western Telephone & Telegraph	104½

Philadelphia:	Closing.
Elec. Co. of America	7¾
Elec. Stor. Bat. c	75¾
Elec. Stor. Bat. pf	75¾
Philadelphia Elec	5¾
Union Traction	44⅛
United G. I. Co	122

Union Traction was one of the animated stocks on the Philadelphia market this week. Electric Company of America, though not very active, was firm upon the strength of promising figures which have been published as to the condition of the company. Electric Storage Battery and United Gas Improvement were also features.

Chicago:	Closing.
Central Union Tel	40
Chicago Edison Light	175
Chicago Telep	175
Metropolitan El. pf	92
National Carbon	25
National Carbon pf	90
Union Traction	19¼
Union Traction pf	57½

Union Traction was a strong feature of the market in Chicago. This was apparently due to the higher quotations which were made for it in New York.

PERSONAL MENTION

MR. P. H. ALEXANDER, one of the "old-timers" in the electrical fraternity, has lately been made general manager of the Magneto Electric Company, a concern making magneto fire-alarm and other apparatus and having its offices in New York and factory at Amsterdam, N. Y.

MR. PATRICK B. DELANY, of South Orange, N. J., lectured before Sibley College, Cornell University, on the eleventh instant on "Synchronous Multiplex and High-Speed Automatic Telegraphy." A large amount of apparatus was used, and a demonstration of 7,000 words per minute given.

MR. A. H. MUSTARD has located an office at No. 120 Liberty street, New York city, where he will represent the Pittsburg Transformer Company as sales agent for New York, northern New Jersey and the New England states. Mr. Mustard has a large acquaintanceship in the electrical field, and was for seven years connected with the Wagner Electric Manufacturing Company in this territory.

MR. FERDINAND LUTHY, a prominent banker and capitalist of Peoria, Ill., and a large owner in the Royal Electric Company of that city, was a New York visitor last week. Mr. Luthy reports business in general quite active in the Middle West, and the Royal company busy filling orders for the alternating machinery which it manufactures. Plans for increased facilities to meet the requirements of its growing business are being considered.

MR. GEORGE G. WARD, vice-president and general manager of the Commercial Cable Company, and Mr. Charles Cuttriss, chief electrician of the same company, are on the Pacific coast arranging for a landing place for the new Pacific cable which their company proposes to lay. The new cable will extend from the California coast at San Francisco to Hawaii and from there to the Philippines, and will be completed to the former island by November of the present year.

LEGAL NOTE

CONTRIBUTORY NEGLIGENCE A BAR TO RECOVERY—The modification of the rule that one guilty of contributory negligence can not recover for injuries negligently inflicted, which permits a recovery in case defendant might, after discovering plaintiff's peril, have avoided the injury, is held in Baltimore Consol. Ry. Co. *vs.* Armstrong (Md.) 54 L. R. A. 424, to be inapplicable, where plaintiff, in attempting to put a parcel on the front platform of a street car, negligently stood on the side toward the other track, and, upon perceiving a car approaching became confused and got caught between the cars and was injured.

ELECTRIC LIGHTING

ENSLEY, ALA.—It is understood that the Central Light and Power Company will begin immediately the erection of its plant for the generation of electricity with which to light the city, as provided in its contract.

NEW ALBANY, IND.—The city electric light plant has been sold by the Light, Heating and Power Company to Chicago investors for $147,000. The same interest is supposed to hold control of the waterworks, by recent purchase.

WILKESBARRE, PA.—The West Electric Light, Heat and Power Company is branching out in all directions, and will, in the course of a few days, be in a position to furnish the residence and business houses of Nanticoke with improved lighting facilities.

DELHI, N. Y.—At the regular session of the board of trustees of Sidney Village, a franchise was granted to the Standard Light, Heat and Power Company to erect poles and wires in that village, subject to regulation of the board, for the purpose of supplying electric lights.

AUGUSTA, GA.—It is announced that an up-to-date plant in every particular will be installed, an underground system being adopted in the principal business sections of the city. The probability is that a mutual cooperative scheme will be effected, each citizen becoming not only a customer but a stockholder.

VANCOUVER, WASH.—The city council has advertised for bids on the proposed sale of the electric lighting plant. The resolution recently passed recites that the city is in need of improved lighting service and that a contract may be entered into by which a municipal plant of sufficient size to meet all requirements for some years may be secured. A franchise will likely be granted for from ten to twenty-five years with certain restrictions.

PHILADELPHIA, PA.—The Electric Company of America, with headquarters in Philadelphia, closed on December 31, 1901, one of the most satisfactory years since it was organized. The net earnings from operating subsidiary companies are largely in excess of the present dividend, and the surplus account shows a credit balance of about $900,000. The company has been putting its various plants in first-class condition and the net earnings from their operation are steadily increasing. It is stated that for the months of January and February of the present year the increase was over thirty per cent in excess of the same months of 1901. It is proposed at the annual meeting, April 22, to eliminate the assessable feature of the stock of the company and reduce the capital to a paid-up basis. The officers of the company are: Colonel A. Loudon Snowden, president; Mr H. T. Hartman, vice-president, and Mr. F. B. Ball, treasurer.

INDUSTRIAL ITEMS

LINDSLEY BROTHERS COMPANY, Menominee, Mich.; Portland, Ore., and Spokane, Wash., makes a specialty of fifty to eighty-foot cedar poles. This company is a wholesale producer, and has facilities for prompt shipment of large contracts.

THE PAWLING & HARNISCHFEGER COMPANY, Milwaukee, Wis., states that the demand for electric traveling cranes is satisfactory in every way. This company has recently booked orders for forty-five cranes and hoists to representative firms throughout the country.

THE STERLING ELECTRICAL MANUFACTURING COMPANY, Warren, Ohio, is the manufacturer of the "Sterling Special" incandescent lamp. This is made with a spiral filament, and is guaranteed to give full-rated candlepower in every direction including the sides and tip of the lamp.

CHARLES WARNER COMPANY, New York city, manufacturer of "Limoid," a prepared lime compound, is distributing a series of eight advertising cards calling attention in quaint and attractive forms to the benefits and economies which may be taken advantage of by the use of this product.

THE STERLING-MEAKER COMPANY, manufacturer of "Sterling" safety brakes, fare registers, sand boxes, fenders and trolley retrievers, will remove on April 30 its office and factory to 420 and 422 Ogden street, Newark, N. J., to which address all mail and shipments should then be sent.

THE D. M. STEWARD MANUFACTURING COMPANY, Chattanooga, Tenn., reports a brisk demand for its patent specialties. This company is widely known as the manufacturer of "Lava" insulators, and also of "Stainoff," a composition for removing grease, paint or ink marks from the person.

"HOLOPHANE" glass is a pressed glass resembling cut glass having vertical prisms on the inside for diffusing the light and horizontal prisms on the outside for directing the light. Globes are made of this glass for particular conditions of lighting and have been in use for some time with success. Holophane glass globes are handled by the Central Electric Company, Chicago.

JAMES S. BARRON & COMPANY, New York city, manufacturers and wholesale dealers in general electric supplies, will occupy their new building on the southwest corner of West Broadway and Franklin street about May 1. The company will have larger accommodations for attending to the wants of its customers, and will be pleased to see its friends in its new headquarters.

THE WARREN ELECTRIC AND SPECIALTY COMPANY, Warren, Ohio, is the manufacturer of the new type "Peerless" lamps. These lamps were recently used, and gave great satisfaction, for the entire illumination of the public square at Cleveland, Ohio, during the G. A. R. encampment. Revised price lists are now ready, cancelling all previous quotations, and these will be sent on application to the company.

THE BERGMAN MANUFACTURING COMPANY, Sacramento, Cal., is placing on the market a new product which is called "Titanite." This is a material which the manufacturer claims is a reliable substitute for hard rubber for electric insulators, a product of the company being the Bergman improved telephone mouthpiece made of titanite. The company will be pleased to open correspondence with those who may be interested.

THE AMERICAN CARBON AND BATTERY COMPANY is the name of the reorganized company of St. Louis, Mo., which has taken over the interests of the Booker Carbon Battery Company. This company will confine its operations particularly to the manufacture of open and closed circuit batteries. New and improved machinery is being installed and the very highest grade carbons for batteries, telephone and electrical construction work will be manufactured.

THE CONSOLIDATED RAILWAY ELECTRIC LIGHTING AND EQUIPMENT COMPANY, general offices 100 Broadway, New York, has produced a magnificent and beautiful "New York Souvenir Calendar." Scenes descriptive of typical places in the greater city are splendidly printed on fine matt paper in photographic tints. Under each reproduction, following the title, is a descriptive verse or paragraph. This is probably the most beautiful calendar which has been issued anywhere at any time.

THE STANDARD POLE AND TIE COMPANY, of 44 Broad street, New York, has received the order from the Dayton, Lebanon & Cincinnati Railroad Company for the poles to be used on the line now under process of construction. This line is being built by the Appleyard-Green Syndicate, the parties who have already built the Dayton, Springfield & Urbana Railroad, and the Columbus, London & Springfield Railway. Southern white cedar or juniper poles were used on both of these roads last year, and proved so satisfactory that they were ordered for the new line.

THE SIMPLEX ELECTRICAL COMPANY, Cambridgeport, Mass., has recently been made the recipient of a monograph presented by the employés of the company. This company has for many years made special efforts to bring about harmonious and kindly relations between the management and the employés, recently promulgating a profit-sharing plan by which some $3,000 was divided among employés who had been in continuous employment for a period of twenty-six months. The evident appreciation of the employés indicates that the expectations of the company are likely to be realized.

F. B. BADT & COMPANY, engineers and general sales agents, Monadnock Block, Chicago, have recently increased their list of agencies. This house has for many years represented the Weston Electrical Instrument Company and the Ward Leonard Electric Company. Among the houses which it represents now in addition are the Osburn Flexible Conduit Company, of New York, manufacturing "Flexduct," and the Perfection Rail Bond Company, manufacturing the "Perfection" rail bond. Professor F. B. Badt, the head of this company, is one of the best known electrical engineers of the United States.

THE BULLOCK ELECTRIC MANUFACTURING COMPANY, of Cincinnati, is sending out a letter signed by Mr. George Bullock, the president, stating that the company is increasing its manufacturing facilities which will make possible the building of machinery in units as large as 10,000 kilowatts capacity. The present works of the company are now running night and day. The letter concludes with the following paragraph replying to statements that are reported to have been circulated respecting the affairs of the company: "The success of the Bullock Electric Manufacturing Company in building both direct and alternating-current machinery and its rapid growth have been phenomenal and the Bullock company is in business to stay."

THE KELLOGG SWITCHBOARD AND SUPPLY COMPANY, Chicago, Ill., is placing on the market a new product called rosin solder. The company has for some time manufactured this material for its own use, it being used exclusively for all its telephone and switchboard work. The relative advantages of rosin solder for telephone purposes are at once apparent, there being no acid whatever used in its manufacture or any other material that would tend to corrode soldered connections. It is much cleaner, more convenient, takes up small space and is wound on spools, the same as wire, and therefore can be had in any quantities. The company at the present time has a capacity of 500 pounds daily. The finished product has the appearance of spools of flattened wire, being about one-eighth of an inch in width. This company will be glad to quote prices on this material in quantities to suit the purchaser.

THE AMERICAN STEEL AND WIRE COMPANY has issued from its Chicago office a card containing the following respecting the Charleston Exposition:

We wish to call your attention to the following facts:

1. There is an exposition at Charleston, S. C.

2. We have an exhibit there.

3. The following statement of facts is endorsed by the Exhibitors' and Concessionaires' Club, representing the largest firms at the exposition.

4. The Charleston Exposition is open for business.

5. The exhibits are in place.

6. Barring Chicago and Buffalo, it is the finest and handsomest exposition ever seen in this country.

7. In electrical lighting it is far ahead of any exposition ever held in this country, excepting Buffalo, and compares very favorably with that.

8. The facilities for reaching the exposition are beyond anything ever offered the public in the way of excursions, a rate of $22.50 having been made from New York to Charleston and return. A proportionate rate being made from other points. Splendid stop-over privileges are given.

9. No city of equal population in the United States has ever tackled a proposition of such magnitude and carried it through with such splendid success.

10. Charleston, with its wonderful historical associations and delightful climate, is well worth a visit.

11. Can't you come down personally and visit it?